First record of *Aphelenchoides besseyi* Christie, 1942 (Nematoda: Aphelenchoididae) in Egypt causing white tip leaf disease on rice

By

A. W. AMIN*

Abstract. A survey of plant parasitic nematodes in the paddies of some governatores in the Nile Delta revealed the presence of *Aphelenchoides besseyi* for the first time in Egypt. The nematode causes „white tip" leaf disease symptoms on the rice leafs which become necrotic followed by reduction in size of the panicle and in size and number of the grains. Morphologically, the Egyptian population well corresponds to the classic descriptions of *A. besseyi*, it shows only in the length of stylet and spicules some minor differences.

More than thirty nematode species are known to be associated with rice plant (*Oryza sativa* L.). Of them, *Aphelenchoides besseyi* Christie, 1942, *Ditylenchus angustus* (Butler, 1913), *Hirschmanniella oryzae* (Breda de Haan, 1902), *Heterodera oryzae* Luc & Berdon Brizuela, 1961 and *Meloidogyne graminicola* Golden & Birchfield, 1965 are the most important. The most common nematode on foliage and flowering parts of rice is *Aplelenchoides besseyi*, the „rice white-tip nematode". It causes the so-called white tip disease. *Aphelenchoides besseyi* is widely prevalent in many (more than thirty) countries causing yield losses up to 17 % (Zhang, 1987), 20 % (Prasad *et al.*, 1987) or 30-40 % (Ichinohe). In India it can cause crop losses up to 45 % (Dwivedi, 1989), or, in Brasil even to 50 % (Da Silva, 1992).

The age of seedlings, placement distances, developmental stages of the nematodes and temperature all influence the attractiveness of rice seedlings to *A. besseyi*. A six-day-old seedling and 30° C temperature are the most favourable, and the basal part of seedling appears to be the main source for release of a possible attractant (Gokta and Mathur, 1988). The nematode can survive for one year inside the rice seeds and 53 days in water under 10° C (Qiu *et al.*, 1991). *Aphelenchoides besseyi* is rather polyphagous and may infect various field crops and ornamental plants, *e.g.* strawberry, Chili pepper, onion, *Setaria, Ficus, Polianthes, Hibiscus*, etc.

*Dr. *Amin Wafdy Amin* (as a guest researcher in the Department of Systematic Zoology and Ecology of the Eötvös Loránd University, Budapest), Department of Agricultural Zoology and Nematology in the Faculty of Agriculture of the Cairo University, Cairo, Egypt.

The white-tip nematode infects rice ectoparasitically in the beginning of rice flowers and hibernates beneath seed glumes as both fourth-stage juveniles and adults (Nandakumar *et al.,* 1975). Once, the nematodes revive and leave the seeds to attack new rice seedlings. Their ectoparasitic feeding on the growing points of rice results whitening or light browning on the upper 3–5 cm of the leaf tips. These become necrotic, twisting include tattered white to brownish leaf tip and distortion of the flag leaf enclosing the panicle.

Materials and methods

In the course of a routine survey, we noticed the symptoms of „white tip" in some paddies in Dakahlia, Sharkia and Kafr El-Sheikh governatores in the Nile Delta Region in Egypt. The nematodes were extracted, an their morphometric data observed. They were identified, especially based on the works of Allen (1952) and Sanwal (1961), as *Aphelenchoides besseyi.* The rice white-tip nematode is hence recorded for the first time in Egypt.

The rice seed samples were collected at flowering and harvest time. Seeds from nematode infected plants of rice varieties „cvs Sakha 101 and 102" showing white tip leaf symptoms were collected from paddies and stored at 10° C until use for extraction. The nematodes were extracted by a modified Baermann tray technique followed by Cobb's sieving method. Rice seed samples were soaked for 48 hours at 20° C. The nematodes were concentrated through Cobb's sieves No. 350 mesh. They were killed and fixed in 5 % hot formalin at 50° C. Measurements were made under a compound microscope.

Aphelenchoides besseyi Christie, 1942

Some main morphological characters of the Egyptian population are as follows.

Female. Body slender. Cuticle marked by very fine transverse striae. Lateral field occupying one-fourth of body diameter, and consisting of three bands (with four incisures). Lip region expanded, wider than neck at base of lips. Lips unstriated with hexaradial inner sclerotization. Stylet sharply pointed anteriorly, basal knobs conspicuous. Median bulb oval, well developed. Nerve ring one body width posterior to median bulb. Excretory pore located a little anterior to nerve ring. Oesophageal glands (lobes) extending five body widths behind the median bulb, joining the oesophagus immediately behind this bulb. Ovary relatively short, oocytes not arranged in tandem. Posterior uterine sack slender, 2-3 body widths long. Tail conoid, terminus armed with four mucronate processes.

Male. Tail curvature about 180 degrees when relaxed by gentle heat. Three pairs of ventro-submedial papillae present, of which the anterior pair

Table 1. Measurements of the Egyptian population of Aphelenchoides besseyi compared with some main literature data

Measurements	Egyptian population	Christie, 1942	Allen, 1952	Fortuner, 1970
Female				
Length	0.54-0.77 (0.66) mm	0.66-0.75 mm	0.62-0.88 mm	0.57-0.84 mm
Width	15-18 (15.9) µm	17-22 µm	-	-
Stylet length	8.5-13 (10.6) µm	-	10 µm	10.0-12.5 µm
Oesophagus length	60-68 (64.1) µm	64-68 µm	-	-
Tail length	30-45 (36.7) µm	36-42 µm	-	-
a	36-51 (41.5)	32-42	38-58	39-53
b	9.7-12.7 (11.5)	10.2-11.4	9-12	9.2-13.1
b'	4.7-6.3 (5.67)	-	-	4.06-5.77
c	15.4-20.1 (18.0)	17-21	15-20	13.8-20.4
V %	69.2-74.6 (71.7)	68-70	66-72	68.7-73.6
Male				
Length	0.52-0.66 (0.58) mm	0.54-0.62 mm	0.44-0.72 mm	0.53-0.61 mm
Width	15-18 (15.9) µm	14-17 µm	-	-
Stylet length	9-12 (9.9) µm	-	-	10.0-12.5 µm
Oesophagus length	55-67 (60.6) µm	63-66 µm	-	-
Tail length	30-39 (33.3) µm	34-37 µm	-	-
Spicules length	15-18 (15.8) µm	-	-	18-21 µm
a	33-42 (34.7)	36-39	36-47	41-47
b	8.9-10.6 (9.8)	8.6-8.8	9-11	8.9-10.7
b'	3.8-5.1 (4.3)	-	-	3.6-4.9
c	15.5-22.0 (18.3)	15-17	14-19	16-20

lying adanal. Spicules strong, ventrally curved. Tail terminus similar to that of female.

A comparison between the Egyptian populations and other ones recorded by Christie (1942), Allen (1952) and Fortuner (1970) is presented in Table 1. Measurements revealed that the present specimens of *A. besseyi* correspond well to the previous descriptions. The stylet and spicula were however a little shorter in the Egyptian animals.

REFERENCES

1. ALLEN, M. W. (1952): Taxonomic status of the bud and leaf nematodes related to Aphelenchoides fragariae (Ritzema-Bos, 1891). - Proc. Helminthol. Soc. Washington, 19: 108–120.

2. Christie, J. R. (1942): A description of Aphelenchoides besseyi n. sp., the summer-dwarf nematode of strawberries, with comments on the identity of Aphelenchoides subtenuis (Cobb, 1926) and Aphelenchoides hodsoni Goodey, 1935. - Proc. Helminthol. Soc. Washington, 9: 82–84.

3. CHRISTIE, J. R. (1959): Plant nematodes. Their bionomics and control. - Gainesville, pp. 256.

4. DWIVEDI, B. K. (1989): Pests problems of rice and their control. - Indian Journ. Helminthol., 41: 61–70.

5. FORTUNER, R. (1970): On the morphology of Aphelenchoides besseyi Christie, 1942 and A. siddiqii n. sp. (Nematoda, Aphelenchoidea). - Journ. Helminthol., 44: 141–152.

7. FRANKLIN, M. T. & SIDDIQI, M. R. (1972): Aphelenchoides besseyi. - C.I.H. Descriptions of Plant-parasitic Nematodes, 1/4: 1–3.

8. GOKTA, N. & MATHUR, V. K. (1988): On the attractivness of paddy seedlings to Aphelenchoides besseyi. - Indian Journ. Nematol., 18: 239–243.

9. ICHINOHE, M. (1972): Nematode diseases of rice. - In: WEBSTER, J. M. (ed.): Economic nematology. London - New York, pp. 563.

10. NANDAKUMAR, C., PRASAD, J. S., RAO, Y. S. & RAO, J. (1975): Investigation on the white-tip nematode, Aphelenchoides besseyi Christie, 1942 of rice (Oryza sativa L.). - Indian Journ. Nematol., 5: 62–69.

11. PRASAD, J. S., PANWAR, M. S. & RAO, Y. S. (1987): Nematode problems of rice in India. - Tropical Pest Management, 33: 127–136.

12. QIU, T. X., YAN, M. F. & LU, Q. (1991): Study on the occurrence, regulation and control of Aphelenchoides besseyi. - Zhejiang-Nongye Kexue, 6: 290–292.

13. SANWAL, K. C. (1961): A key to the species of the nematode genus Aphelenchoides Fischer, 1894. - Canad. Journ. Zool., 39: 143–148.

14. DA SILVA, G. S. (1992): White tip and national rice production. - Inf. Agropec. Belo-Horizonte, 16: 57–59.

15. ZHANG, Y. L. (1987): The occurrence and control of Aphelenchoides besseyi. - Hubei Agric. Sci., 1: 15–16.

A taxonomic review of the genera *Aporcelaimus* Thorne & Swanger, 1936 and *Metaporcelaimus* Lordello, 1965 (Nematoda, Aporcelaimidae)

By

I. ANDRÁSSY*

Abstract. Two genera of the family Aporcelaimidae are briefly discussed, their species enumerated and outlined by main morphological-morphometrical characters. *Aporcelaimus* Thorne & Swanger, 1936 contains large to very large nematodes, 4 to 10 mm. Out of the 50 nominal species, eighteen are regarded as valid. *Metaporcelaimus* Lordello, 1965 consists of smaller species, 2 to 4 mm. Thirteen species are listed. *Aporcelaimium* Loof & Coomans, 1970 is considered a junior synonym of *Metaporcelaimus*.

Several new synonyms, combinations (comb. n.) and new names (nom. n.) are proposed. Identification keys to species of both genera are added. Both *Aporcelaimus* and *Metaporcelaimus* are demonstrated by some figures.

In a previous paper dealing with some *Aporcelaimus* species (Andrássy, 2000 a, page 153), I wrote: „Within the scope of the present paper there is no way of going over all the nominal or »good« species of *Aporcelaimus,* later on, however, I want to come back to some taxonomic problems within the genus". Well, I take now the opportunity and make an attempt to come closer to this group in order to solve one or other problems in their taxonomy.

In their fundamental works, first Thorne and Swanger (1936), then Thorne (1939, 1974), T. and J. B. Goodey (1951, 1963), Heyns (1965) and Jairajpuri and Ahmad (1992) outlined *Aporcelaimus* and grouped its species. Several other authors published additional morphological-taxonomical data to the knowledge of the genus. Of them, Altherr, Meyl and Loof shall be mentioned by name. Myself also have endeavoured to add new observations to the topic.

However, who once dealt with this group of nematodes, knows it from experience that an orientation within the „mass" of species needs a very hard work. The reason is complex. The great quantity of nominal species (half a hundred) and the often so insufficient or not clear descriptions of, particularly older, taxa, on the one hand, the rather inexact definition of the genus *Aporce-*

**Dr. István Andrássy,* ELTE Állatrendszertani és Ökológiai Tanszék, MTA Zootaxonómiai Kutatócsoport (Department of Systematic Zoology and Ecology of the Eötvös Loránd University, Zootaxonomy Research Group of the Hungarian Academy of Sciences), 1088 Budapest, Puskin u. 3, Hungary.

laimus itself, or the uncertain distinguishing marks between it and related genera, on the other hand, all these increase the difficulties.

This paper does not want to present a complete classification of the Aporcelaimidae nor *Aporcelaimus* proper. I am only trying to give a little clearer picture of these nematodes. The emphasis falls on the more exact outlining of the genus *Aporcelaimus* and a closely relative, *Metaporcelaimus,* as well as on the characterization of their species, in order to give some assistance in orientation among them.

Aporcelaimus Thorne & Swanger, 1936

Aporcelaimidae. Large to exceedingly large nematodes, body size varying between (3–) 4 and 10 mm. Body strongly tapering towards the anterior end, head as wide as 1/4 or 1/5 of body width at neck base. Cuticle thick, marked with fine criss-cross lines especially visible on tail. Labial region offset by a deep constriction, lips large, practically not separated from one another. Amphids stirrup-shaped with fine medial support. Oral opening a dorso-ventral slit. Odontostyle 17 to 42 µm, nearly equal to labial width or little longer, aperture large, either measuring 2/3 to 3/4 of the stylet length or occupying uits total dorsal side. Guiding sheath thin. Oesophagus strongly muscular, gradually widening from before its middle. Oesophageal nucleus AS_1 closer to AS_2 than to D. Female genital system amphidelphic, vulva transverse, predominantly with cuticularized lips, vagina often very strongly developed. Spicula of two types: either slender, dorylaimoid, or strongly swollen, with spacious lumen. Male supplements varying in number from 7 to 30, mostly spaced, rarely contiguous, the posterior ones sometimes lying within range of spicula. Tails similar in both sexes, predominantly shorter than anal body diameter, conoid-rounded or bluntly rounded, occasionally with slightly subdigitate terminus. Males generally as common as females.

Type species: *Dorylaimus superbus* de Man, 1880 = *Aporcelaimus superbus* (de Man, 1880) Goodey, 1951.

The genus contains eighteen species considered valid:

A. americanus Thorne & Swanger, 1936

A. bestiarius Isatullaeva, 1967
A. jugeti Altherr, 1974 syn. n.

A. boreus Andrássy, 2000

A. brzeskii Andrássy, 2000

A. caesar Andrássy, 2000

A. cobbi Thorne, 1937

A. digiticaudatus nom. n.
Aporcelaimus superbus apud T. Goodey, 1951
Aporcelaimus superbus apud Bongers, 1988 syn. n.

A. **eurydoris** (Ditlevsen 1911) Thorne & Swanger, 1936
Dorylaimus eurydoris Ditlevsen, 1911
A. wilhelmschneideri Altherr, 1965 syn. n.
Aporcelaimellus wilhelmschneideri (Altherr, 1965) Altherr, 1974
Aporcelaimus amphidysis Anderson, 1966 syn. n.
Aporcelaimus elegans Thorne, 1974 syn. n.

A. **femineus** Andrássy, 2000

A. **fortis** Gagarin, 1992

A. **ingens** nom. n.
Aporcelaimus eurydoris apud Thorne & Swanger, 1936

A. **macrohystera** Altherr, 1974
Dorylaimus regius apud Steiner, 1925 syn. n.
Aporcelaimus regius apud Thorne & Swanger, 1936 syn. n.

A. **pachydermus** Thorne, 1937
A. ronnebergeri Altherr, 1968 syn. n.

A. **paraspiralis** Thorne & Swanger, 1936
Dorylaimus spiralis apud Micoletzky, 1922

A. **pseudospiralis** Botha & Heyns, 1990
Aporcelaimus spiralis apud Thorne & Swanger, 1936 (nec Cobb, 1893) syn. n.

A. **sicus** Gagarin, 1992

A. **subdigiticaudatus** Altherr, 1965

A. **superbus** (de Man, 1880) Goodey, 1951
Dorylaimus superbus de Man, 1880
Aporcelaimus minor Altherr, 1954 (nec Loos, 1945)
Aporcelaimus parvus Altherr in Lordello, 1955

Remarks. Thorne and Swanger (1936) originally designated *Dorylaimus regius* de Man, 1876 as type species of *Aporcelaimus.* Loof and Heyns (1997) pointed out, that this species was insufficiently described, never found again with certainty, and the only specimen (a female) destroyed. They asked the International Commission on Zoological Nomenclature for accepting *Dorylaimus superbus* de Man, 1880 as the type of the genus.

Aporcelaimus can generally be characterized in having large body, practically not separate lips, short odontostyle with long aperture, AS_1 nucleus lying closer to AS_2 than D, gradually widening oesophagus, transverse vulva, short and broadly rounded tail, and males mostly as common as females.

Within the family Aporcelaimidae there is a genus, *Aporcelaimellus* Heyns, 1965, which especially resembles *Aporcelaimus* in several morphological features. The line between them is not quite sharply drawn. And what is more, *Aporcelaimellus* is also a very rich genus including not less than 70 nominal species. Still, who has got some experience in studying these genera, that can distinguish them with more or less certainty. *Aporcelaimellus* can be distinguished from *Aporcelaimus* as follows. First, *Aporcelaimellus* consists

of smaller and plumper species, between 1 and 3 mm. Then, the exocuticle shows very fine striation but no criss-cross lines, and the endocuticle is composed of two layers (as seen through the optical microscope) of different refraction which is especially prominent on the tail; the outer layer seems to be „transparent", the inner layer more „compact". Furthermore, the stylet aperture is never so long than in *Aporcelaimus,* it occupies maximal half the odontostyle length; the vulva is small, pore-like or a short slit. It is possible that some difference between the two genera exists also in the map of the oesophageal gland nuclei, in this field, however, our observations are still incomplete. Non-morphological features may also characterise our two genera. While *Aporcelaimus* species, as big nematodes in general, occur in small individual numbers, but usually in both genders, the species of *Aporcelaimellus* are in great individual number present, but predominantly in female form only.

Out of the half-a-hundred nominal species of *Aporcelaimus,* I first present those which can be considered valid representatives of the genus. I make an attempt to outline and separate them by their brief morphological or morphometrical characters. In a separate list the remaining (nominal) species are enumerated with their recent taxonomic or nomenclatorial status.

Distribution. The members of the genus are probably at home over the Globe; as far as known, merely Australia lacks data of their distribution. Most records have been published from Europe, from 18 countries.

Aporcelaimus americanus Thorne & Swanger, 1936

a) Thorne and Swanger, 1936, Virginia, Ohio *(Aporcelaimus americanus):*

Females: L = 5.0–7.0 mm, a = 45; b = 5.2; c = 100; V = 49 %; c' = 0.7.
Males: L = 5.0–7.0 mm; a = 41; b = 4.7; c = 100; c' = 0.7.

Cuticle much thicker than odontostyle. Odontostyle fairly slender, equally long to labial width, aperture 2/3 of its length. Eggs as long as body diameter. Spicula slightly swollen. Supplements 12–15, spaced, posterior one or two levelling with the spicula. Tail broadly rounded.

b) Loof and Coomans, 1970, Holland, France, USA *(Aporcelaimus americanus):*

Map of oesophageal gland nuclei:

D = 52–54 %	AS_1 = 33–34 % AS_2 = 54 % PS_1 = 75–76 %
K = 58–66 %	PS_2 = 76–77%

c) Andrássy, 2000 b, Hungary *(Aporcelaimus americanus):*

Females: L = 7.00–7.27 mm; a = 50–53; b = 5.5–6.8; c = 104–125; V = 50–54 %; c' = 0.8–0.9.

Males: L = 7.70–7.74 mm; a = 50–51; b = 5.8–6.0; c = 116–118; c' = 0.7–0.8.

Labial region 29–30 µm wide, 1/4 to 1/5 of body width at posterior end of oesophagus. Cuticle thicker than odontostyle. Odontostyle 28–29 µm, as long as labial width, aperture 2/3 of its length. Eggs as long as body diameter. Spicula 200–210 µm, moderately swollen. Supplements 15–16, separate, posterior one or two within the range of spicula. Tail 50–57 µm (female) or 65–71 µm (male), conoid-rounded with blunt tip. Oesophageal glands:

D = 51–55 %	AS_1 = 26–30 % AS_2 = 48–52 % PS_1 = 70–71 %
K = 57–60 %	PS_2 = 72–73 %

Remarks. In the percentage arrangement of the oesophageal gland nuclei there is some difference in Loof and Coomans and in Andrássy: the AS_1 and PS nuclei were located more posteriorly according to the observation of the former authors. There are two possibilities: either the not too great differences are still within the range of the species, or the West-European authors have studied a though similar but different species. In their paper, Loof and Coomans gave no other morphological data; thus, their animals cannot be compared with my Hungarian ones.

Aporcelaimus americanus can be characterized by its large body size, thick cuticle, comparatively long odontostyle, short eggs, large and swollen spicula and presence of 12–16 supplements of which one or two lie within the range of the spicula.

Distribution. Europe: Holland, France, Poland, Hungary; North America: United States (Virginia, Ohio).

Aporcelaimus bestiarius Isatullaeva, 1967
(Fig. 1 A–E)

a) Isatullaeva, 1967, Kazakhstan *(Aporcelaimus bestiarius):*

Females: L = 3.69–4.00 mm; a = 31–36; b = 4.7–5.0; c = 69–83; V = 47–49 %.
Males: L = 4.60–5.00 mm ; a = 28; b = 4.7–5.0; c = 78–80; c' = 0.9.

Cuticle somewhat thinner than stylet. Odontostyle massive, about 22–23 µm, as long as labial diameter; aperture 2/3 of its length. Vagina half the body width. Spicula slender, about 110 µm long. Supplements 24, posterior one or two within range of spicula. Tail conoid-rounded with narrow terminus.

b) Altherr, 1974, Germany *(Aporcelaimus jugeti):*

Male: L = 4.0 mm; a = 37; b = 4.5; c = 75; c' = 1.0.

Cuticle a little thinner than stylet. Head as wide as 1/4 body diameter at posterior end of oesophagus. Odontostyle stout, 26–28 µm, equal to head width, aperture 2/3. Spicula 115 (–120) µm, slender. Supplements 17, posterior 2 within spicular range. Tail conoid with slightly dorsally bent tip.

c) Present specimens, Hungary, one female, two males:

Female: L = 4.05 mm; a = 35; b = 5.3; c = 70; V = 45 %; c' = 0.8.
Males: L = 4.28–4.56 mm; a = 37–38; b = 5.5–65; c = 80–85; c' = 0.7.

Cuticle thinner than stylet. Labial region 23–27 µm wide. Odontostyle robust, 23–27 µm, as long as cephalic width; aperture occupying 2/3 its length. Vulva strongly sclerotized, vagina half as long as body diameter. Spicula slender, 120–130 µm. Supplements 17–21, mostly spaced, the posterior 2 within range of spicula. Female tail 54 µm, male tail 50–52 µm long, the former more bluntly rounded than the latter.

Locality: Buda Mountains in central Hungary, soil and fallen leaves from an oak forest, April 1970.

Remarks. Altherr described *Aporcelaimus jugeti* in both sexes, queried however if the female was conspecific with the male. Indeed, I mention in a recent paper (Andrássy, 2000 a) that the female belongs in all likelihood to an other species of the Swiss author, *Aporcelaimus conicaudatus* (now: *Metaporcelaimus labiatus;* see there). Luckily, Altherr has designated the male specimen for holotype, thus that represents the species *A. jugeti.*

Aporcelaimus bestiarius and *A. jugeti* (the male!) agree in all main characters with each other: body size and figure, thin cuticle, stout stylet, slender spicula, great number of supplements of which the posterior two levelling with spicula. Slight differences can be found only in length of odontostyle (22 *vs.* 26–28 µm) and number of supplements (24 *vs.* 17). However, the recent animals from Hungary show a fine transition in these latter characters: odontostyle 23–27 µm, supplements 17–21. I feel well-founded to consider them to be one and the same species.

A smaller and less slender species. The shape and length of odontostyle, the slender spicula and the number and arrangement of supplements are characteristic for it.

Distribution. Germany, Hungary, Kazakhstan.

Aporcelaimus boreus Andrássy, 2000

Andrássy, 2000 a, Alaska *(Aporcelaimus boreus):*

Males: L = 3.46-4.06 mm; a = 30–33; b = 4.2–4.6; c = 56–70; c' = 0.9-1.0.

Lip region 28–29 µm wide, about 1/4 of body width at neck base. Cuticle as thick as or somewhat thinner than spear. Odontostyle 30–32 µm, nearly equal in length to the labial width, aperture 2/3 of its length. Spicula slender, 135–147 µm. Supplements 18–23, contiguous, their series begin a little before the spicula. Tail 55–61 µm, convex-conoid with narrowly rounded tip. Map of oesophageal nuclei:

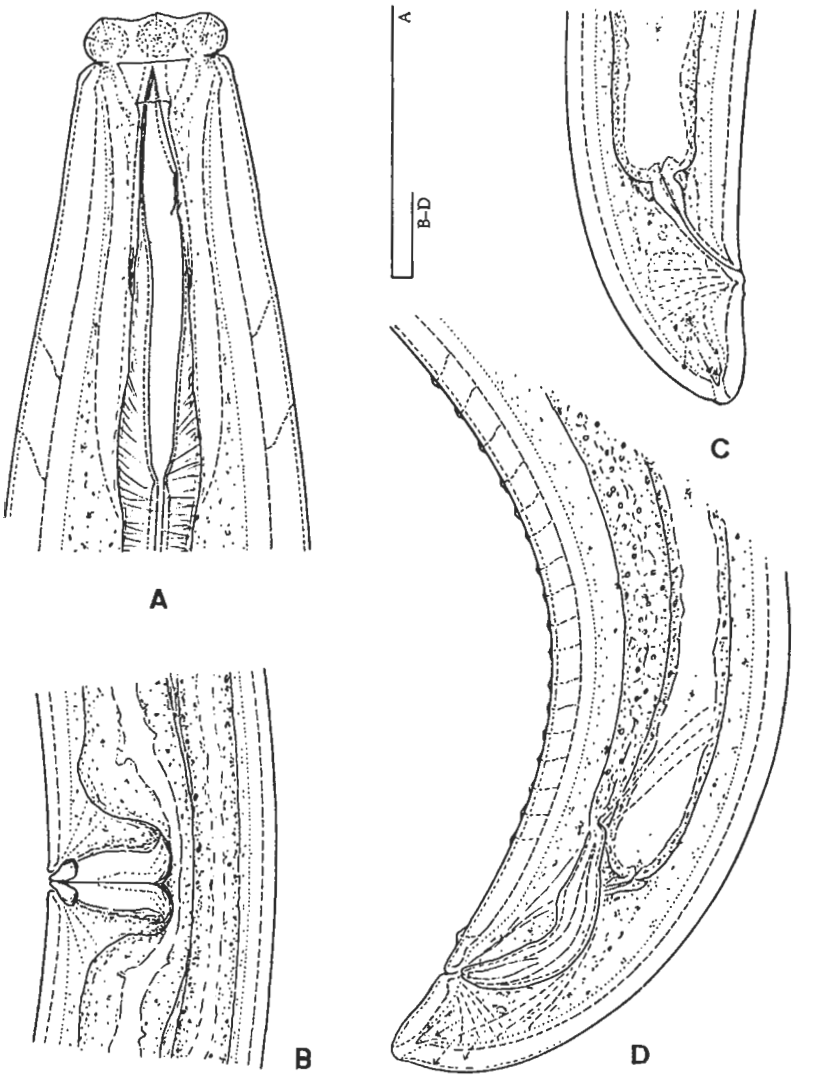


Fig. 1. *Aporcelaimus bestiarius* Isatullaeva, 1967 from Hungary - a typical representative of the genus. A: anterior end; B: vulval region; C: female tail; D: male posterior end. (Scale bars 50 µm each)

D = 51–52 %	AS_1 = 21–22 % AS_2 = 42–46 % PS_1 = 71–73 %
K = 47–52 %	PS_2 = 72–73 %

Remarks. *Aporcelaimus boreus* belongs to the smaller species of the genus. It resembles *A. superbus*, the odontostyle is however much longer (30–32 *vs.* 17–22 µm), the spicula as well (*vs.* 80–100 µm), the supplements are more numerous (*vs.* 14–19) and in most part contiguous.

Distribution. United States (Alaska).

Aporcelaimus brzeskii Andrássy, 2000

Andrássy, 2000 a, Alaska *(Aporcelaimus brzeskii):*

Females: L = 4.10–4.26 mm, a = 26–30; b = 4.5–4.8; c = 60–72; V = 52–55 %; c' = 10.7–0.8.

Males: L = 3.89–4.41 mm; a = 27–34; b = 4.5–5.0; c = 70–82; c' = 0.7–1.0.

Lip region 27–29 µm wide, about 1/4 of body width at posterior end of oesophagus. Cuticle nearly as thick as spear. Odontostyle 30–33 µm, a little longer than labial width, aperture measuring 2/3 of its length. Eggs shorter than body width. Spicula 170–190 µm, slender. Supplements 12–18, separate, the posterior 4 to 6 levelling with spicula. Female tail 63–70 µm, male tail 48–60 µm, the latter somewhat more conoid than the former. Oesophagus nuclei:

D = 51–52 %	AS_1 = 20–23 % AS_2 = 42–45 % PS_1 = 73–74 %
K = 48–52 %	PS_2 = 74–76 %

Remarks. *Aporcelaimus brzeskii* is a relatively small representative of the genus. It is distinctive because of the slender vagina, short eggs, slim and long spicula and the number and arrangement of supplements (a fairly great number of them levelling with spicula).

Distribution. United States (Alaska).

Aporcelaimus caesar Andrássy, 2000

Andrássy, 2000 b, Hungary *(Aporcelaimus caesar):*

Females: L = 10.05–10.50 mm; a = 58–60; b = 6.8–7.0; c = 128–132; V = 46–52 %; c' = 0.8.

Males: L = 7.50–8.64 mm; a = 45–57; b = 5.4–6.4; c = 94–138; c' = 0.7–0,8.

Labial region 35–36 µm wide. Cuticle thicker than stylet. Odontostyle 35–37 µm, equal to labial width, aperture occupying 3/4 of its length. Eggs 1.5 times longer than body width. Spicula 210–230 µm, of slender type. Supplements 23 to 27, contiguous or nearly so, all before the spicula. Female

tail 63–68 µm, male tail 67–68 µm, both bluntly conoid-rounded. Oesophageal gland nuclei:

D = 56–59 %	AS_1 = 28–31 % AS_2 = 47–52 % PS_1 = 72–75 %
K = 58–62 %	PS_2 = 73–76 %

Remarks. This is the biggest species within the genus and the whole family: body length to 10.5 mm. Its other characteristics are the very thick cuticle, posterior position of nucleus D, very large and slender spicula and the great number of male supplements. There is a sole species that has more supplements (30): *Aporcelaimus fortis.*

Distribution. Hungary.

Aporcelaimus cobbi Thorne, 1937

Thorne, 1937 and 1939, Italy *(Aporcelaimus cobbi):*

Male: L = 5.0 mm; a = 43; b = 5.0; c = 77; c' = 1.1.

Aperture 3/4 of odontostyle. Spicula fairly slender. Supplements 17, the anterior ones spaced, the posterior ones contiguous; 3 or 4 supplements to be found within range of spicula. Tail conoid with slightly dorsally bent tip.

Remarks. Primary diagnostic feature distinguishing *Aporcelaimus cobbi* is the dorsally bent tail; it differs in this respect from all the other species of the genus. The relatively large number of supplements levelling with the spicula is also characteristic for it.

Distribution. Italy.

Aporcelaimus digiticaudatus nom. n.

a) T. Goodey, 1951, England *(Aporcelaimus superbus):*

Females: L = 3.22–4.40 mm; a = 27–33; b = 4.4–5.9; c = 60–69; V = 45–48 %.
Males: L = 3.00–4.10 mm; a = 30–34; b = 4.5–5.5; c = 62–68; c' = 0.8.

Cuticle as thick as odontostyle. Odontostyle about 28 µm, equal to head diameter, aperture 2/3 of its length. Spicula slender, about 180 µm long. Supplements 13–17, separate, the posterior two lying within range of spicula. Tail spherical with digitate tip.

b) Bongers, 1988, Holland *(Aporcelaimus superbus,* microphotos*):*

Cuticle a little thinner than odontostyle. Odontostyle 25 µm, aperture 2/3 of its length. Spicula slender. Tail with broadly digitate tip.

Remarks. The nematodes *„Aporcelaimus superbus"* of Goodey and Bongers are hardly conspecific with *superbus* of de Man (1880), but undoubtedly identical with each other. The spicula are longer (180 µm *vs.*

hardly 100 µm), the posterior supplements lie within range of spicula and, what is also important, the tail is clearly digitate. I think, it is more advisable to give a new name to this species: *Aporcelaimus digiticaudatus* nom. n.

This species is differentiated from all the others by its tail shape. It belongs to the small members of the genus, and can be characterized also by the rather plump body, long odontostyle, slender spicula and number and arrangement of supplements.

Distribution. Holland and United Kingdom. It is not impossible that some data of *A. superbus* also refer to this species.

Aporcelaimus eurydoris (Ditlevsen, 1911) Thorne & Swanger, 1936

a) Ditlevsen 1911, Denmark *(Dorylaimus eurydoris):*

Male: L = 7.0 mm; c' = 0.8.

Cuticle about as thick as odontostyle. Neck slightly constricted at stylet level. Odontostyle shorter than labial width with very large aperture. Spicula swollen. Supplements 16, mostly separate, lying far before the spicula. Tail conoid-rounded.

b) Heyns, 1965 *(Aporcelaimus eurydoris,* figures only*):*

Odontostyle about 18–20 µm, shorter than labial width, aperture 3/4 of its length.

c) Thorne, 1974, South Dakota *(Aporcelaimus eurydoris,* male*):*

Male: L = 6.5 mm; a = 68; b = 5.8; c = 117; c' = 1.1.

Cuticle about as thick as odontostyle. Neck with slight constriction. Odontostyle 21 µm, aperture as long as the ventral wall of stylet. Spicula thick. Supplements 12, spaced, anterior to the spicula. Tail conoid-rounded.

As supposed by Loof (1999), the immature females illustrated under moulting very probably belong to *Epacrolaimus declinatoaculeatus* (Kreis, 1924) Andrássy, 2000.

d) Loof, 1999 *(Aporcelaimus eurydoris):*

Vagina slender, about half body width long.

e) Altherr, 1965, Germany *(Aporcelaimus wilhelmschneideri):*

Male: L = 5.75 mm, a = 57; b = 7.0; c = 110; c' = 0.9.

Cuticle as thick as odontostyle. Odontostyle fairly slender, 21 µm, shorter than cephalic diameter, aperture nearly as long as the ventral wall. Spicula 90 µm, fairly plump. Supplements 11, spaced, far before the spicula. Tail broadly rounded.

f) Anderson, 1966, Canada *(Aporcelaimus amphidysis):*

Females: L = 6.2–7.3 mm; a = 51–60; b = 5.1–5.8; c =106–147; V = 53–58 %; c' = 0.8.
Males: L = 6.3–6.4 mm; a = 46–48; b = 5.0–5.2; c = 105–107, c' = 0.8.

Cuticle as thick as odontostyle. Head 28 µm wide. Odontostyle 19–20 µm, aperture about 3/4 of its length. Spicula of swollen type, 113–139 µm. Supplements 9–12, well spaced, far before the spicula. Tail broadly rounded.

g) Thorne, 1974, Minnesota, North and South Dakota *(Aporcelaimus elegans):*

Females: L = 7.5–8.2 mm; a = 65–82; b = 5.7–6.2; c = 95–110; V = 52 %; c' = 0.9.
Males: L = 7.5–9.3 mm; a = 68–85; b = 5.2–7.2; c = 130–158; c' = 0.8.

Neck slightly constricted. Cuticle about as thick as odontostyle. Odontostyle 18–20 µm, shorter than labial width, aperture nearly as long as the ventral wall. Spicula strongly swollen. Supplements 9–16, spaced, far anterior to spicula. Tail broadly rounded in both sexes.

Remarks. To all probability, *Aporcelaimus eurydoris* sensu Thorne and Swanger (1936) is a different species (see *A. ingens*). It is obvious that *Aporcelaimus eurydoris* of Schuurmans Stekhoven and Teunissen (1938) is also another species. Though it is nearly as large as the true *eurydoris* and has swollen spicula, the odontostyle is slender with quite short aperture and, in addition, the supplements are uncommonly few, only three. As Baqri and Coomans (1973) noted, the single original specimen was lost.

According to Anderson, *Aporcelaimus amphidysis* differs only in length of the oesophagus and position of the nerve ring from Altherr's *A. wilhelmschneideri.* These are however minor and insignificant differences. What is more, both these taxa completely correspond to the diagnosis of *A. eurydoris* (in shape of head, shape and length of odontostyle and its aperture, swollen spicula, number and arrangement of supplements, broadly rounded tail as well as in the body size). I consider therefore both *Aporcelaimus wilhelmschneideri* and *A. amphidysis* junior synonyms of *A. eurydoris.* (In 1974 Altherr suggested to transfer his *wilhelmschneideri* to *Aporcelaimellus,* but I agree with Loof, 1999, that was not a lucky step.)

Aporcelaimus elegans Thorne, 1974 is also identical with *A. eurydoris.* The shape of head, neck, odontostyle, its aperture, the size of body and tail all are similar in both taxa. The higher number of the supplements (16) is the same as on Ditlevsen's animal, the lower number (9) either may be within the range of the species or it concerns another species found in one of the localities mentioned by Thorne.

Loof (1999) supposed that *Dorylaimus regius* of Steiner (1925) is conspecific with *A. eurydoris.* Indeed, it is reminiscent of that species (especially in shape and length of the odontostyle), their spicula are however expressively of the slender type, and the last supplement lies within the spicular range. In my opinion, the nematodes of Steiner are the same as *Aporcelaimus macrohystera* (see there).

Aporcelaimus eurydoris is a very large and slender nematode with unusually short odontostyle in comparing its body size, very large spear

aperture, massive spicula and with a slight constriction on the neck.

Distribution. Europe: Holland, Germany, Denmark, Poland, Austria, Slovakia, Spain, Ukraine, Russia; North America: United States (Minnesota, North and South Dakota), Canada.

Aporcelaimus femineus Andrássy, 2000

Andrássy, 2000 a, Alaska *(Aporcelaimus femineus):*

Females: L = 4.28–5.00 mm; a = 35–41; b = 3.9–4.2; c = 65–80; V = 49–51 %; c' = 0.8–0.9.

Labial region 32–35 µm, about as wide as 1/4 body width at posterior end of oesophagus. Cuticle thicker than stylet. Odontostyle long and fairly slender, 40–42 µm, 1.2–1.3 labial diameters, aperture occupying less than 2/3. Vulval lips practically not sclerotized. Eggshell sculptured. Tail 55–63 µm, conoid-rounded with a minute projection directed dorsad. Spermatozoa not observed in uteri even in gravid females. Oesophageal nuclei:

D = 47–49 %	AS_1 = 29–33 % AS_2 = 50–52 % PS_1 = 73–74 %
K = 58–59 %	PS_2 = 75–76 %

Remarks. The long and slender odontostyle, the position of nucleus D in oesophagus, the mammillate eggshell, as well as the tail shape are good distinguishing characters for this species. Whether or not it is a true monosexual form? There is another species known in female gender only, *A. pseudospiralis;* it has however a much shorter odontostyle (23–26 µm).

Distribution. United States (Alaska).

Aporcelaimus fortis Gagarin, 1992

Gagarin, 1992, Russia *(Aporcelaimus fortis):*

Male: L = 7.18 mm; a = 26; b = 7.0; c = 73; c = 0.65.

Body plump. Cuticle much thinner than odontostyle. Labial region 35 µm wide. Odontostyle 30 µm, aperture longer than ventral wall. Spicula very large and robust, 228 µm. Supplements 30, contiguous, the posterior one nearly levelling with anterior tips of spicula. Tail short, broadly rounded.

Remarks. A large species characterized by the very long odontostyle aperture, thin cuticle and strongly swollen spicula. In addition, *Aporcelaimus fortis* has the most numerous supplements within the genus.

Distribution. Russia (Asian part).

Aporcelaimus ingens nom. n.

Thorne & Swanger, 1936, Utah, Arizona *(Aporcelaimus eurydoris):*

Female: L = 7.9 mm; a = 52; b = 5.6; c = 143; V = 49 %; c' = 0.8.
Male: L = 7.1 mm; a = 56; b = 5.2; c = 111; c' = 0.9.

Cuticle thinner than odontostyle. Odontostyle about 28 µm, somewhat longer than labial width, aperture 2/3 of its length. Spicula about 180 µm, swollen. Supplements 8 to 14, spaced, before the spicula. Tail in female broader than in male.

Remarks. *Aporcelaimus eurydoris* of Thorne and Swanger (1936) appears to be different from the „true" *eurydoris* of Ditlevsen (1911), as well as from *A. elegans* Thorne, 1974 (which is a synonym of *eurydoris*; see there). Although it agrees with them in the large body size and shape of spicula, clearly differs in having a thinner cuticle (*vs.* as thick as or thicker than odontostyle), a longer odontostyle with shorter aperture (28 µm, aperture 2/3 *vs.* 18–21 µm, distinctly shorter than cephalic diameter, aperture occupying the whole dorsal side) and a less slender body (*vs.* a = 65–85).

A new name, *Aporcelaimus ingens* nom. n. is suggested for this species. (The word *ingens* comes from Latin and means „huge" or „very large".) This species belongs to the biggest representatives of the genus. It strongly resembles *A. sicus* (similar length of body and odontostyle, swollen spicula, nearly the same number of supplements), but this latter species has a very large aperture being equal in length to the ventral wall of the stylet.

Distribution. United States (Utah, Arizona).

Aporcelaimus macrohystera Altherr, 1974

a) Altherr, 1974, Germany *(Aporcelaimus macrohystera):*

Female: L = 6.15 mm; a = 55; b = 5.0; c = 133; V = 49 %; c' = 0.6.

Cuticle thicker than odontostyle. Odontostyle 28 µm, equal to head diameter, aperture longer than 3/4. Vagina very strong, 3/4 body width long. Tail 45 µm, hemispherical.

b) Steiner, 1925, Germany, Norway, Pennsylvania *(Dorylaimus regius):*

Females: L = 5.68–7.82 mm; a = 38–51; b = 6.1–6.4; c = 93–154; V = 47–52 %; c' = 0.5–0.8.
Male: L = 5.85 mm; a = 47; b = 5.7; c = 101; c' = 0.8.

Odontostyle as long as or somewhat shorter than labial width, aperture very large, as long as the ventral wall of odontostyle. Spicula slender. Supplements 17, the anterior ones slightly spaced, the posterior ones contiguous, posterior one or two within range of spicula. Female tail broadly rounded, hemispherical, male tail convex-conoid with blunt tip.

c) Thorne and Swanger, 1936, Germany, England, Norway *(Aporcelaimus regius):*

Female: L = 6.9 mm; a = 47; b = 6.7; c = 100; c' = 0.7.
Male: L = 5.8 mm; a = 47; b = 5.9; c = 71; c' = 0.8.

Cuticle nearly as thick as spear. Odontostyle shorter than cephalic diameter, aperture very large, equal to ventral length of odontostyle. Spicula of the slender type. Supplements 16, contiguous, the series beginning within range of spicula. Tail bluntly rounded.

d) Coomans, 1966, Zaire *(Aporcelaimus* sp.*):*

Male: L = 3.65 mm; a = 26; b = 4.8; c = 61; c' = 0.9.

Cuticle as thick as odontostyle. Odontostyle 27 µm, nearly equal to labial diameter, aperture as long as its ventral wall. Spicula slender, 138 µm. Supplements 16, irregularly spaced, posterior two within range of spicula. Tail 63 µm, conoid, narrowly rounded on tip.

Remarks. As already mentioned (Page 5), *Dorylaimus regius* de Man, 1876 – designated as the type of *Aporcelaimus* by Thorne and Swanger – is a rather badly described species and hardly belongs to the genus *Aporcelaimus* (it was probably a *Sectonema).* Hence, the under the name *„Dorylaimus regius"* or *„Aporcelaimus regius"* mentioned species of Steiner, and Thorne and Swanger, respectively, are no way identical with de Man's nematode. They are *Aporcelaimus,* and most probably identical with each other. *Aporcelaimus* sp. of Coomans may also belong to them; it shows the same very characteristic shape of the odontostyle and a more or less similar arrangement of the supplements. However, the latter species is considerably smaller, the odontostyle longer and the tail more conoid.

The species of Steiner and Thorne and Swanger are in all probability the same as *Aporcelaimus macrohystera.* Loof (1999) also supposed the identity between *macrohystera* and *regius* sensu Thorne and Swanger.

This *Aporcelaimus* species belongs to the group possessing an extremely long stylet aperture. The large body, relatively short odontostyle, very strong vagina, slender spicula, presence of 16–17 supplements of which the posterior ones level with spicula, are further characters of this species.

Distribution. Germany, Norway, United Kingdom, United States, and (maybe) Zaire.

Aporcelaimus pachydermus Thorne, 1937
(Fig. 2 A–E)

a) Thorne, 1937 and 1939, Mississippi *(Aporcelaimus pachydermus):*

Female: L = 4.7 mm; a = 36; b = 5.1; c = 100; V = 51 %; c' = 0.7.
Male: L = 4.8 mm; a = 33; b = 5.6; c = 83; c' = 0.5.

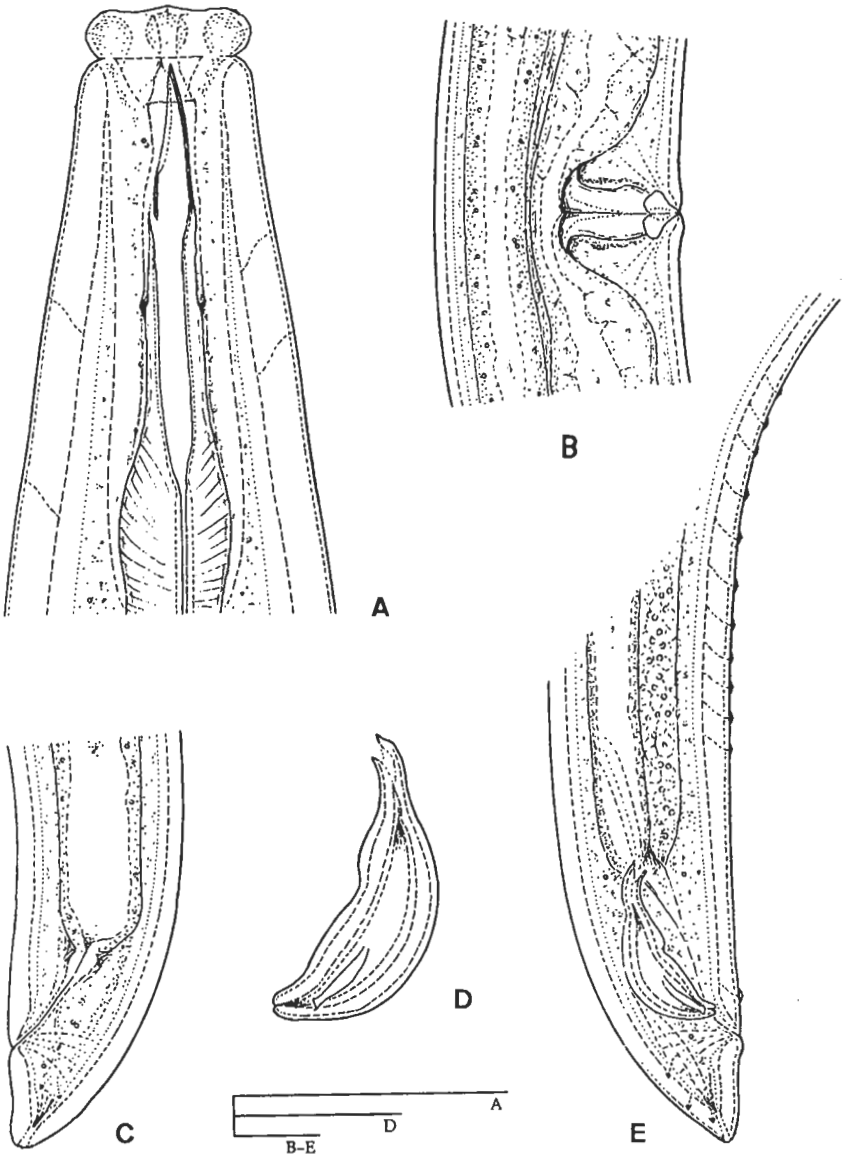


Fig. 2. *Aporcelaimus pachydermus* Thorne, 1937 from Hungary – a typical representative of the genus. A: anterior end; B: vulval region; C: female tail; D: spiculum; E: male posterior end. (Scale bars 50 μm each)

Cuticle very thick, occupying almost half the neck width at latitude of the odontostyle. Odontostyle as long as labial width, aperture occupying 3/4 (rather 2/3) of its length. Spicula strongly swollen in their posterior half. Supplements 8, spaced, before the spicula. Tail broadly rounded, especially in male.

b) Thorne, 1974, Nebraska, South Dakota *(Aporcelaimus pachydermus):*

Female: L = 6.5 mm; a = 38; b = 5.9; c = 108; V = 48 %; c' = 0.7.
Male: L = 6.4 mm; a = 57; b = 7.0; c = 134; c' = 0.7.

Cuticle thicker than spear. Odontostyle 30 µm, as long as labial diameter, aperture 2/3 of its length. Spicula very massive. Supplements 10, irregularly spaced, all before the spicula. Tail broadly rounded, especially in male.

c) Altherr, 1968, Germany *(Aporcelaimus ronnebergeri):*

Male: L = 5.70 mm; a = 40; b = 5.4; c = 70; c' = 1.2.

Head as wide as 1/4 body width at cardial region. Cuticle thicker than stylet. Odontostyle 30 µm, equal to labial width, opening 2/3. Spicula 120 µm, plump. Supplements 7, spaced, lying before the spicula. Tail slightly subdigitate.

d) Altherr, 1974, Germany *(Aporcelaimus ronnebergeri):*

Females: L = 3.86–5.55 mm; a = 46–52; b = 4.6–6.0; c = 71–105; V = 44–55 %.
Males: L = 4.00–6.20 mm; a = 37–57; b = 4.5–5.4; c = 72–120.

Head as wide as 1/3 or 1/4 body width at cardial region. Cuticle thick. Odontostyle 30–31 µm, aperture 2/3 of its length. Vagina strong, 2/3 body width long. Spicula 100–120 µm. Supplements 7 to 10, spaced. Tail conoid-rounded, sometimes subdigitate.

e) Present specimens, Hungary, 3 females, 4 males:

Females: L = 5.60–6.14 mm; a = 44–59; b = 5.0–5.6; c = 97–114; V = 51–52 %; c' = 0.8.
Males: L = 5.21–6.17 mm; a = 45–53, b = 4.9–5.6, c = 82–107; c' = 0.9.

Cuticle thicker than stylet, occasionally very thick (almost half the neck width at same level). Labial region 27–30 µm, 1/4 body width at posterior end of oesophagus. Odontostyle 27–29 µm, equal to labial diameter; aperture 2/3 of stylet length. Vulva well sclerotized, vagina occupying half the body diameter or more. Spicula strongly swollen, 106–112 µm long. Supplements 10–12, separated, all before the spicula. Female tail 54–58 µm, male tail 57–65 µm, the former more bluntly rounded on terminus than the latter. Map of oesophageal gland nuclei:

D = 51–57 %	AS_1 = 26–28 % AS_2 = 47–49 % PS_1 = 68–72 %
K = 54–60 %	PS_2 = 69–74 %

Locality: Buda Mountains, Hungary, soil from an oak forest, January 1971.

Remarks. According to their descriptions, *Aporcelaimus pachydermus* and *A. ronnebergeri* cannot be separated from each other. They are equal in all principal characters, *viz.* body size and shape, thickness of cuticle, length and shape of odontostyle, figure and length of spicula, number and arrangement of supplements, etc. Moreover, the present Hungarian specimens completely fit the diagnosis of both of them. *Aporcelaimus ronnebergeri* is therefore regarded as junior synonym of *A. pachydermus.*

Its medium size, very thick cuticle, plump spicula, number and arrangement of supplements and shape of tail may characterize *Aporcelaimus pachydermus.*

Distribution. Germany, Austria, Hungary, United States (Mississippi, Nebraska, South Dakota).

Aporcelaimus paraspiralis Thorne & Swanger, 1936

a) Micoletzky, 1922, Austria, Rumania *(Dorylaimus spiralis?):*

Female: L = 5.80–6.35 mm; a = 41–44; b = 5.0; c = 100–105; V = 46–51 %.
Male: L = 6.40 mm; a = 42, b = 5.7; c = 97; c' = 0.8.

Cuticle thicker than odontostyle. Odontostyle about as long as labial width, aperture seemingly as long as ventral wall of stylet. Spicula slim. Supplements 23, almost contiguous, the posterior 4 levelling with spicula. Tail nearly hemispherical.

b) Thorne and Swanger, 1936 *(Aporcelaimus paraspiralis):*

The same data as above.

Remarks. Since *Dorylaimus spiralis* apud Micoletzky appeared to be different from Cobb's *spiralis* (Micoletzky himself also queried their identity), Thorne and Swanger proposed a separate name for it.

Aporcelaimus paraspiralis is very close to *A. macrohystera* in having the same body size, very long odontostyle aperture, thick cuticle, short tail. The only difference between them can be found in the supplements: they are more in *paraspiralis* (23 *vs.* 16–17). Whether this difference is or not enough to separate them?

Distribution. Austria, Rumania.

Aporcelaimus pseudospiralis Botha & Heyns, 1990

a) Botha and Heyns, 1990, South Africa *(Aporcelaimus pseudospiralis):*

Females: L = 3.64–4.42 mm; a = 31–35; b = 4.5–5.1; c = 58–73; V = 50–53 %; c' = 1.0.

Cuticle nearly as thick as stylet. Labial region 23–27 µm wide. Odontostyle 23–26 µm, equal to cephalic diameter, aperture 2/3 of its length. Vulva not sclerotized. Tail narrowly rounded. No sperms in mature females.

b) Thorne and Swanger, 1936, Sumatra *(Aporcelaimus spiralis):*

Female: L = 4.3 mm; a = 43; b = 5.2; c = 83; V = 55 %; c' = 1.0.

Cuticle thinner than odontostyle. Odontostyle about as long as labial width, aperture nearly 2/3 of its length. Eggs longer than body width. Tail narrowly rounded. No sperms in gravid females.

Remarks. *„Aporcelaimus spiralis* (Cobb, 1893)" of Thorne and Swanger (1936) is surely not identical with *Dorylaimus spiralis* Cobb, 1893. Although Cobb described his species without any figures, so much can be ascertained, he had a nematode being very different from any *Aporcelaimus.* He wrote: „The rather slender spear slides in a pharyngeal ring and can be clearly traced back a distance three times as great as the width of head". That means, his animal possessed a very long odontostyle, maybe a longidoroid one. Therefore, it is difficult to understand, how could Thorne and Swanger identify their species with that of Cobb? Because of the insufficient description, Cobb's *spiralis* cannot be realised. It remains a *species inquirenda.*

According to Botha and Heyns, their South African species, *A. pseudospiralis,* somewhat differs in the shape of labial region and amphid from *spiralis* sensu Thorne and Swanger. These are however quite insignificant differences. In the validity, these species cannot be separated from each other. A plus argument to their identity: *pseudospiralis* has been found only in females without spermatozoa in uteri, just as *spiralis* of Thorne and Swanger. Since the species name of the American authors cannot be retained, the next valid name must be used, *Aporcelaimus pseudospiralis.*

„Aporcelaimus spiralis" of Williams (1959) is an *Aporcelaimellus:* the body is small (2.1–2.5 mm), the aperture only half the stylet length and the tail shows double cuticle layers just being typical for the latter genus. I agree with Heyns who suggested a separate name for this species within *Aporcelaimellus: A. williamsi* Heyns, 1965.

Aporcelaimus discoides Jain, Saxena & Sharma, 1994 seems to be close to *A. pseudospiralis,* it is possibly identical with that. This species has been described in female gender only with not sclerotized vulval lips. Unfortunately, I know this species only from „second hand"; my efforts for obtaining the original description were unsuccessful.

Aporcelaimus pseudospiralis is the second species of the genus known in female gender only, and with non-sclerotized vulval lips; the other one is *A. femineus* (see there). *A. pseudospiralis* clearly differs from the latter in having an essentially shorter odontostyle (23–26 *vs.* 40–42 µm). If it is also a true monosexual species?

Distribution. South Africa, Sumatra.

Aporcelaimus sicus Gagarin, 1992

Gagarin, 1992, Russia *(Aporcelaimus sicus):*

Female: L = 7.62 mm; a = 56; b = 5.2; c = 115; V = 47 %; c' = 0.6–0.8.
Males: L = 6.5–7.8 mm; a = 31–37; b = 5.2–5.5; c = 91–118; c' = 0.6–0.8.

Labial region 27–30 µm wide. Cuticle thinner than odontostyle. Odontostyle 26–30 µm, aperture seemingly as long as the ventral wall. Spicula very plump, 190–200 µm. Supplements 10–13, separate, all lying far before the spicula. Tail conoid-rounded.

Remarks. *Aporcelaimus sicus* is a large nematode characterized by the very long odontostyle aperture, the uncommonly swollen spicula and the number and arrangement of supplements. It seems to be closely related to *A. eurydoris,* its stylet is however longer (26–30 *vs.* 18–21 µm, shorter than labial width).

Distribution. Russia (Asian part).

Aporcelaimus subdigiticaudatus Altherr, 1965

Altherr, 1965, Germany *(Aporcelaimus subdigiticaudatus):*

Females: L = 5.50–5.90 mm; a = 36–44; b = 6.4–6.7; c = 98–130; V = 48–51 %.
Males: L = 4.70–5.95 mm; a = 39–40; b = 4.6–6.2; c = 95–98; c' = 1.0.

Cuticle nearly as thick as odontostyle. Labial region 1/4 or 1/5 as wide as body at proximal end of oesophagus. Odontostyle 28 µm, 1.2 times head diameter, aperture as long as its ventral wall. Vagina massive, half the body width. Eggs often very numerous, up to 25 in one female. Spicula slender, 150 µm. Supplements 15–16, spaced, before the spicula. Tail subdigitate.

Remarks. *Aporcelaimus subdigiticaudatus* is of average body length with very long stylet aperture, large number of eggs, slender spicula and medium number of supplements. The subdigitate tail seems to be especially characteristic for it.

Distribution. Germany.

Aporcelaimus superbus (de Man, 1880) Goodey, 1951

a) De Man, 1880 and 1884, Holland, Germany *(Dorylaimus superbus):*

Females: L = 4.5 mm; a = 30–40; b = 5; c = 60–85; V somewhat before mid-body; c' = 1.1.
Males: L = 4.5 mm; a = 30–40; b = 5; c = 60–75; c' = 0.9.

Spicula slender. Female genital organ very long, eggs numerous. Supplements 14–18, separate, all anterior to the spicula. Tail conoid, narrowly tipped.

b) Loof, 1961, Holland *(Aporcelaimus superbus):*

Holo- and paratype females: L = 3.67–3.73 mm; a = 30; b = 4.8; c = 59–62; V = 44 %; c' = 1.0.

Paratype males: L = 3.16–3.64 mm; a = 37–41; b = 4.5–4.8; c = 63–65; c' = 1.2.

Cuticle thinner than odontostyle. Anterior end strongly tapered, head as wide as 1/5 body diameter at neck base. Odontostyle 17–18 µm, 1.1–1.4 times the labial width, aperture 2/3 of stylet. Spicula slender, 100 µm. Supplements 15–19. Tail conoid, narrowly rounded, at male more pointed than at female.

c) Altherr, 1954, Switzerland *(Aporcelaimus minor):*

Female: L = 3.00 mm; a = 28; b = 4.3; c = 63; V = 50 %.

Cuticle thinner than spear. Odontostyle 22 µm, equal to labial width, aperture 2/3 of its length. Tail narrowly rounded on tip.

d) Radu and Popovici, 1967, Rumania *(Aporcelaimus superbus):*

Females: L = 2.4–4.2 mm; a = 18–28; b = 4.6–6.0; c = 67–80; V = 46–51 %.
Male: L = 2.4 mm; a = 23; b = 4.1; c = 58.

Cuticle thick. Odontostyle about as long as labial width, aperture 2/3 its length. Spicula slender. Supplements 14, anterior to spicula.

Remarks. Thorne and Swanger (1936) designated *Dorylaimus regius* de Man, 1880 for type species of their genus, *Aporcelaimus.* Loof and Heyns (1997) pointed out that this species of de Man was rather insufficiently described, never discovered again with certainty, and the single original specimen was destroyed. They suggested therefore to the Commission on the Zoological Nomenclature to accept *Dorylaimus superbus* de Man, 1880 as type species of *Aporcelaimus.*

As Meyl (1961) also noted, *Aporcelaimus minor* Altherr, 1954 (nec Loos, 1945, therefore renamed by Altherr in Lordello, 1955 as *A. parvus*) agrees with *A. superbus* very well. In accordance with him, I propose to consider *A. parvus* a junior synonym of de Man's species.

The species of Radu and Popovici appears very similar to *A. superbus,* only the cuticle is thicker than the stylet.

Aporcelaimus superbus is a short species. The thin cuticle, short stylet, long female genital organ, numerous small eggs, slender spicula, number and arrangement of supplements, and the conoid tail are characteristic for it.

Distribution. Holland, Belgium, Germany, Switzerland, Scotland, Poland, Austria, Slovakia, Spain, Italy, Rumania, Moldavia, Lithuania, Belorussia, Russia, Uzbekistan, Kazakhstan. (If all these data refer to *A. superbus* indeed?)

Other species described in, or transferred to *Aporcelaimus* ,

In addition to the eighteen species discussed above as valid, there is a good number of further species (32) that have been either described as

Aporcelaimus or transferred from other genera to it. Unfortunately, there is no way here to enter the details, therefore I only enumerate them and indicate their current taxonomic status.

A. amphidysis Anderson, 1966 = synonym of *Aporcelaimus eurydoris* syn. n.

A. balticus (Schulz, 1934) Andrássy, 1986 = *species inquirenda seu incertae sedis.*

A. cocophilus Loos, 1949 = *Aporcelaimellus cocophilus* (Loos, 1949) comb. n.

A. conicaudatus Altherr, 1953 = synonym of *Metaporcelaimus labiatus* syn. n.

A. declinatoaculeatus (Kreis, 1924) Thorne & Swanger, 1936 = *Epacrolaimus declinatoaculeatus* (Kreis, 1924) Andrássy, 2000.

A. digitalis Loos, 1949 = *Metaporcelaimus digitalis* (Loos, 1949) comb. n.

A. discoides Jain, Saxena & Sharma, 1994 = probably identical with *A. pseudospiralis.* (The original paper was not obtainable.)

A. elegans Thorne, 1974 = synonym of *Aporcelaimus eurydoris* syn. n.

A. ferrugineus Lordello, 1955 = *Tubixaba ferruginea* (Lordello, 1995) comb. n.

A. gerlachi Meyl, 1956 = *Aporcelaimellus gerlachi* (Meyl, 1956) Heyns, 1965.

A. jugeti Altherr, 1974 = synonym of *Aporcelaimus bestiarius* syn. n.

A. krygeri (Ditlevsen, 1928) Brzeski, 1962 = *Aporcelaimellus krygeri* (Ditlevsen, 1928) Heyns, 1965.

A. laetificans (Andrássy, 1956) Andrássy, 1958 = *Paraxonchium laetificans* (Andrássy, 1956) Altherr & Loof, 1969.

A. mamillatus Williams, 1959 = *Aporcelaimellus mamillatus* (Williams, 1959) Heyns, 1965.

A. minor Altherr, 1954 = synonym of *Aporcelaimus parvus* [Altherr in Lordello, 1955].

A. minor Loos, 1945 = *Makatinus minor* (Loos, 1945) Ahmed, 1997.

A. mulveyi Brzeski, 1962 = synonym of *Eudorylaimus arcus* [Andrássy, 1992].

A. nivalis (Altherr, 1952) Altherr, 1952 = *Aporcelaimellus nivalis* (Altherr, 1952) Heyns, 1965.

A. obscurus (Thorne & Swanger, 1936) Goodey, 1961 = *Aporcelaimellus obscurus* (Thorne & Swanger, 1936) Heyns, 1965.

A. papillatus (Bastian, 1865) Andrássy, 1986 = *species inquirenda seu incertae sedis.*

A. paraconicaudatus Meyl, 1956 = *Aporcelaimellus paraconicaudatus* (Meyl, 1956) Heyns, 1965.

A. parvus Altherr in Lordello, 1955 = synonym of *Aporcelaimus superbus.*

A. profundis (Cobb, 1904) Andrássy, 1986 = *species inquirenda seu incertae sedis.*

A. regius (de Man, 1880) Thorne & Swanger, 1936 = *species inquirenda seu incertae sedis* [Loof and Heyns, 1997].

A. romanicus Popovici, 1978 = *Metaporcelaimus romanicus* (Popovici, 1978) comb. n.

A. ronnebergeri Altherr, 1968 = synonym of *Aporcelaimus pachydermus* syn. n.

A. seinhorsti Meyl, 1957 = *Aporcelaimellus seinhorsti* (Meyl, 1957) Heyns, 1965.

A. spiralis (Cobb, 1893) Thorne & Swanger, 1936 = *species inquirenda seu incertae sedis.*

A. sublabiatus (Thorne & Swanger, 1936) Brzeski, 1962 = *Metapor-celaimus sublabiatus* (Thorne & Swanger, 1936) comb. n.

A. vanderlaani Meyl, 1957 = *Aporcelaimellus vanderlaani* (Meyl, 1957) Heyns, 1965.

A. vorax Thorne & Swanger, 1936 = synonym of *Epacrolaimus declinato-aculeatus* [Andrássy, 2000 b].

A. wilhelmschneideri Altherr, 1965 = synon. of *Aporcelaimus eurydoris* syn. n.

Key to species of Aporcelaimus

1 Aperture very long, equal to the ventral wall of odontostyle 2
– Aperture 2/3 to 3/4 of odontostyle 7

2 Spicula strongly swollen, particularly in their posterior half 3
– Spicula slender, of general dorylaimoid type 5

3 Supplements 30, contiguous. – L = 7.2 mm ..... **fortis** Gagarin
– Supplements 9 to 16, separate 4

4 Odontostyle 26–30 µm, equal to labial diameter. – L = 6.5–7.8 mm ..... **sicus** Gagarin
– Odontostyle 18–21 µm, distinctly shorter than labial diameter. – L = 5.8–7.3 mm . **eurydoris** (Ditlevsen)

5 Tail subdigitate. – L = 4.7–5.9 mm ..... **subdigiticaudatus** Altherr
– Tail broadly rounded, not subdigitate 6

6 Supplements 23, contiguous. – L = 5.8–6.4 mm ... **paraspiralis** Thorne & Swanger
– Supplements 16–17, separate. – L = 5.7–7.8 mm ..... **macrohystera** Altherr

7 Monosexual (?) species, no sperms in uteri of gravid females; vulval lips not sclerotized 8
– Bisexual species, males nearly as common as females; vulval lips sclerotized ... 9

8 Odontostyle 40–42 µm long. – L = 4.3–5.0 mm ..... **femineus** Andrássy
– Odontostyle 23–26 µm long. – L = 3.6–4.4 mm ..... **pseudospiralis** Botha & Heyns

9 Tail conoid, dorsally bent. – L = 5.0 mm ..... **cobbi** Thorne
– Tail conoid-rounded to hemispherical, not bent dorsally 10

10 Very big nematodes, average body length 6 to 10 mm 11
– Smaller nematodes, average body length 4 to 5 mm 13

11 Odontostyle 35–37 µm, aperture 3/4; spicula slender. – L = 7.5–10.5 mm .....
caesar Andrássy
– Odontostyle 28–29 µm, aperture 2/3; spicula swollen 12

12 Cuticle thicker than odontostyle; supplements 12–16. – L = 5.0–7.7 mm .....
americanus Thorne & Swanger
– Cuticle thinner than odontostyle; supplements 8–14. – L = 7.1–7.9 mm .....
ingens nom. n.

13 Cuticle distinctly thinner than stylet; odontostyle 17–20 µm long. – L = 3.0–4.5 mm ..... **superbus** (de Man)
– Cuticle as thick as or thicker than stylet; odontostyle 23 to 33 µm long 14

14 Spicula swollen; supplements 7–10. – L = 3.9–6.5 mm ..... **pachydermus** Thorne
– Spicula slender; supplements 12 to 23; body 3–4 (–5) mm 15

15 Tail digitate: hemispheric with a terminal peg. – L = 3.0–4.4 mm .....
digiticaudatus nom. n.
– Tail not digitate 16

16 All supplements lying before the spicula. – L = 3.5–4.1 mm ..... **boreus** Andrássy
– Posterior supplements within range of spicula 17

17 Spicula 170–190 µm long; supplements 12–18, 4–6 within spicular range. – L = 3.9–4.4 mm ..... **brzeskii** Andrássy
– Spicula 110–130 µm long; supplements 17–24, 2 within spicular range. – L = 3.7–5.0 mm ..... **bestiarius** Isatullaeva

Metaporcelaimus Lordello, 1965

Syn. *Aporcelaimium* Loof & Coomans, 1970.

Aporcelaimidae. Body size between 1.6 and 4.1 mm. Cuticle thick, mostly with fine transverse striae; its layers apparently similar in structure (refraction). Labial region sharply offset, high and narrow, only as wide as 1/5 to 1/8 body width at posterior end of oesophagus. Lips hardly separate. Odontostyle 14 to 23 µm, equal to labial diameter or slightly longer; aperture large, 1/2 to 3/4 of its length. Guiding sheath thin, aporcelaimoid. Oesophagus rather gradually widened at its mid-region. Oesophageal nucleus AS_1 lying closer to D than to AS_2. Female genital system amphidelphic, vulva

transverse, predominantly with sclerotized lips. Spicula slender with narrow lumen. Male supplements 2 to 16, spaced; except for one species, all supplements lying before the spicula. Tails in both sexes similar, conoid, longer (up to twice) than anal body width, terminus often slightly subdigitate. Males generally present, and nearly as frequent as females.

Type species: *Metaporcelaimus mombucae* Lordello, 1965.

For the moment, thirteen species may be placed here:

M. adoxus (Tjepkema, Ferris & Ferris, 1971) comb. n.
Aporcelaimellus adoxus Tjepkema, Ferris & Ferris, 1971

M. angusticollis nom. n.
Aporcelaimellus capitatus apud Thorne, 1974

M. capitatus (Thorne & Swanger, 1936) comb. n.
Dorylaimus capitatus Thorne & Swanger, 1936
Eudorylaimus capitatus (Thorne & Swanger, 1936) Andrássy, 1959
Aporcelaimellus capitatus (Thorne & Swanger, 1936) Heyns, 1965
Drepanodorus monohystera Brzeski, 1964 syn. n.
Paraxonchium monohystera (Brzeski, 1964) Altherr & Loof, 1969 syn. n.

M. coomansi (Baqri & Khera, 1975) comb. n.
Aporcelaimellus coomansi Baqri & Khera, 1975

M. digitalis (Loos, 1949) comb. n.
Aporcelaimus digitalis Loos, 1949
Aporcelaimellus shamimi Ahmad, 1995 syn. n.
Aporcelaimellus sublabiatus apud Thorne, 1974 syn. n.

M. efficiens (Cobb in Thorne & Swanger, 1936) comb. n.
Dorylaimus efficiens Cobb in Thorne & Swanger, 1936
Eudorylaimus efficiens (Cobb in Thorne & Swanger, 1936) Andrássy, 1959
Aporcelaimellus efficiens (Cobb in Thorne & Swanger, 1936) Baqri & Khera, 1975

M. invisus (Tjepkema, Ferris & Ferris, 1971) comb. n.
Aporcelaimellus invisus Tjepkema, Ferris & Ferris, 1971

M. labiatus (de Man, 1880) comb. n.
Dorylaimus labiatus de Man, 1880
Eudorylaimus labiatus (de Man, 1880) Andrássy, 1959
Aporcelaimium labiatum (de Man, 1880) Loof & Coomans, 1970
Aporcelaimus conicaudatus Altherr, 1953 syn. n.
Aporcelaimellus conicaudatus (Altherr, 1953) Monteiro, 1970 syn. n.

M. mombucae Lordello, 1965
Aporcelaimellus mombucae (Lordello, 1965) Loof, Jairajpuri & Ahmad, 1995
Aporcelaimellus indicus Baqri & Jairajpuri, 1968 syn. n.
Aporcelaimellus conicaudatus apud Monteiro, 1970 syn. n.

M. oceanicus nom. n.
Aporcelaimus conicaudatus apud Williams, 1959
Aporcelaimellus conicaudatus apud Heyns, 1995

M. romanicus (Popovici, 1978) comb. n.
Aporcelaimus romanicus Popovici, 1978

M. simplex (Thorne & Swanger, 1936) comb. n.
Dorylaimus simplex Thorne & Swanger, 1936
Aporcelaimellus simplex (Thorne & Swanger, 1936) Loof & Coomans, 1970

M. sublabiatus (Thorne & Swanger, 1936) comb. n.
Dorylaimus sublabiatus Thorne & Swanger, 1936
Eudorylaimus sublabiatus (Thorne & Swanger, 1936) Andrássy, 1959
Aporcelaimus sublabiatus (Thorne & Swanger, 1936) Brzeski, 1962
Aporcelaimellus sublabiatus (Thorne & Swanger, 1936) Thorne, 1974
Aporcelaimus conicaudatus apud Andrássy, 2000 syn. n.

Remarks. When studying the positions of the oesophageal gland nuclei in dorylaimoid nematodes, Loof and Coomans (1970) called the attention that *Eudorylaimus labiatus* (de Man, 1880) Andrássy, 1959 clearly belongs to the family Aporcelaimidae. According to them, it differs from *Aporcelaimus* species by transversally striated cuticle without criss-cross lines, absence of an oesophago-intestinal disc and a hexagonal oral opening, furthermore by the very low value of K in the oesophageal gland map (K = 30–32 *vs.* 50–70). It differs from the representatives of *Aporcelaimellus* by the transverse vulva, thin outer layer of cuticle and also by the low value of K. They suggested a new genus for *labiatus: Aporcelaimium* Loof & Coomans, 1970.

Some years prior to the publication of Loof and Coomans, Lordello described a new aporcelaimoid nematode from Brazil and erected at the same time a separate genus for it: *Metaporcelaimus mombucae* Lordello, 1965. He regarded the structure of the oesophagus as main distinguishing character for his genus: „*Metaporcelaimus* differs from its closely resembling genus, *Aporcelaimus* Thorne & Swanger, 1936, in having oesophagus made up of three regions, a cardia-like structure being seen between the posterior and middle parts". It is hardly questionable that Lordello's nematode was a wounded specimen in its oesophagus: this organ was either broken or twisted or bent in, and showed therefore that unusual appearance. What is however much more important, the Brazilian nematode is in all other characters very closely related to the type species of *Aporcelaimium*. No question, they (together with a number of further species, see below) belong to one and same genus; in other words, *Metaporcelaimus* is a senior synonym of *Aporcelaimium*.

As defined above, *Metaporcelaimus* is a good genus for a group of closely related species of the family Aporcelaimidae. The shape of labial region and stylet, the arrangement of oesophageal nuclei and the shape and length of tail can mainly characterize it. It is reminiscent of both the genera *Aporcelaimus* Thorne & Swanger, 1936 and *Aporcelaimellus* Heyns, 1965. It differs from *Aporcelaimus* in the higher and narrower labial region, the comparatively anterior position of the AS_1 nucleus (*vs.* it is closer to AS_2 than to D, hence the value of K is higher), the always slender (dorylaimoid) spicula (*vs.* they are often strongly swollen with wide lumen), the shape and length of tail (*vs.* this is always shorter than one anal diameter and more broadly rounded), and the smaller body (*vs.* to 10 mm). From *Aporcelaimellus* it may be separated in the

above mentioned characters (except for body length) as well as in the structure of cuticle (the „inner" cuticle is seemingly homogeneous under light microscope in *Metaporcelaimus*, but it shows two distinct layers in *Aporcelaimellus* with different refraction of light, especially expressed on the tail), the generally longer aperture of the odontostyle (*vs.* 1/2 odontostyle length or shorter) and the slender body. In addition, males are much more frequent (or know at all) in *Metaporcelaimus* than in *Aporcelaimellus*.

After going through the nominal species of the genera *Aporcelaimus* Thorne & Swanger, 1936, *Aporcelaimellus* Heyns, 1965, and in part of *Eudorylaimus* Andrássy, 1959, I found some of them to be very similar to both *Metaporcelaimus mombucae* and *Aporcelaimium labiatum*. We may suppose that these species are congeneric with the latter ones. True however, one important character of *Aporcelaimium*, namely the fairly close position of the oesophageal nucleus AS_1 to the dorsal nucleus (and hence the lower value of K), is known only in four of these species *(coomansi, labiatus, simplex* and *sublabiatus)*. But also the remaining species fit the diagnosis of *Metaporcelaimus* (syn. *Aporcelaimium*) in all other morphological-anatomical structures very well. Of course, our knowledge on taxonomy of *Metaporcelaimus* – as well as of *Aporcelaimus* and *Aporcelaimellus* – is far from complete. Further investigations would be welcome in order to paint a clearer picture on both these genera themselves and the species placed in them. So, it is easily possible that additional species of the genus *Aporcelaimellus* may actually belong to *Metaporcelaimus*.

Distribution. As far as known, the genus *Metaporcelaimus* is distributed in Europe, Asia, Africa, North and South America.

Metaporcelaimus adoxus (Tjepkema, Ferris & Ferris, 1971) comb. n.

Tjepkema, Ferris and Ferris, 1971, Indiana *(Aporcelaimellus adoxus)*:

Females: L = 1.60–1.95 mm; a = 26–33; b = 3.6–4.0; c = 38–45; V = 48–54 %; c' = 1.2–1.3.

Cuticle very finely annulated, nearly as thick as stylet. Head 18–20 µm wide. Odontostyle 20–23 µm, a little longer than labial diameter, aperture 2/3 of its length. Vulval lips sclerotized. One egg, 1.5 times as long as body width. Female tail 39–45 µm long, dorsally convex, conoid, occasionally slightly subdigitate on tip.

Remarks. *Metaporcelaimus adoxus* is very close to *M. simplex*, and only differs from that in having shorter eggs (*vs.* twice the body width) and a somewhat different shape of tail. It is similar to *M. mombucae* as well, the odontostyle is however longer (20–23 *vs.* 14–19 µm) and the tail shorter (1.2–1.3 times *vs.* 1.6–1.9 times anal body width).

Distribution. United States (Indiana).

Thorne, 1974, Colorado, Montana *(Aporcelaimellus capitatus):*

Female: L = 2.8 mm; a = 44; b = 4.6; c = 55; V = 56 %; c' = 1.4.

Head somewhat discoid, but very narrow, body at posterior end of oesophagus 8 times wider than head. Cuticle as thick as stylet. Odontostyle 14 µm, shorter than labial width, opening half its length. Tail with relatively blunt tip.

Remarks. *„Aporcelaimellus capitatus"* of Thorne, 1974, is hardly identical with the original species of Thorne & Swanger, 1936. The head is somewhat discoid and extremely narrow, only 1/8 (!) of the body width at neck base, the odontostyle smaller (14 *vs.* 20–22 µm), shorter than labial diameter, and the cuticle thicker (as thick as spear). The two *„capitatus"* agree essentially in one character: the relatively short (1/2) aperture of the odontostyle. It seems to be advisable if we use a separate species name for the nematode of Thorne, 1974 as proposed above.

Metaporcelaimus angusticollis is clearly distinctive because of its very strongly narrowed anterior region. The shape of head, and the short odontostyle with relatively small aperture are further important characters for this species.

Distribution. United States (Colorado, Montana).

Metaporcelaimus capitatus (Thorne & Swanger, 1936) comb. n.

a) Thorne and Swanger, 1936, Utah *(Dorylaimus capitatus):*

Female: L = 2.3 mm; a = 41; b = 5.0; c = 59; V = 49 %; c' = 1.5.
Male: L = 2.5 mm; a = 52; b = 5.2; c = 63; c' = 1.3.

Head 1/3 as high as wide. Cuticle thinner than odontostyle. Odontostyle about 20–22 µm, 1.3 times the labial width; opening about 1/2 of its length.

Supplements 5–9, well spaced, all lying far before the spicula. Tail comparatively blunt on tip.

b) Tjepkema, Ferris and Ferris, 1971, Indiana *(Aporcelaimellus capitatus):*

Females: L = 2.17–2.40 mm; a = 35–44; b = 4.4–4.9; c = 49–62; V = 52–58 %; c' = 1.1–1.3.
Males: L = 2.05–2.44 mm; a = 38–45; b = 4.4–5.4; c = 50–72; c' = 1.0–1.1.

Cuticle finely annulated. Labial region 15–18 µm wide. Odontostyle 1.2–1.3 times as long as labial width, 21–23 µm, aperture half its length. Vulva a short transverse slit with sclerotized lips. Eggs twice as long as body diameter. Spicula 52–54 µm. Supplements 4–5. Female tail 37–44 µm, male tail 33–45 µm, both dorsally convex with fairly blunt tip.

c) Brzeski, 1964, Poland *(Drepanodorus monohystera):*

Female: L = 3.1 mm; a = 32; b = 4.5; c = 41; V = 47 %; c' = 1.6.

Body at posterior end of oesophagus about 5 times wider than head. Cuticle thinner than stylet. Odontostyle 20 µm, 1.1 times the labial width, opening about 1/2. Tail comparatively bluntly rounded. „Monodelphic".

d) Heyns, 1989, Poland *(Paraxonchium monohystera):*

Holotype female: L = 3.04 mm; a = 30; b = 4.6; c = 46; V = 48 %; c' = 1.4.

Cuticle thinner than spear. Odontostyle 20.5 µm, 1.2 times the labial width, aperture somewhat longer than 1/2 of its length. Dorsal oesophageal gland in 54 % of oesophagus length. Tail quite exactly the same as drawn by Thorne and Swanger.

Remarks. Already Tjepkema, Ferris and Ferris noted that „*A. capitatus* is rather atypical of *Aporcelaimellus,* and may be more typical of *Aporcelaimium"* (now: *Metaporcelaimus*).

Heyns studied and redescribed the holotype (and only specimen) of Brzeski's *Drepanodorus (=Paraxonchium) monohystera,* and stated that the species did have two gonads; the anterior branch of the genital system was overlooked by Brzeski. Heyns also emphasized, this species is not a typical *Paraxonchium,* but it shows a close resemblance to *Aporcelaimellus.* In fact, *monohystera* shows all the criteria of the genus *Metaporcelaimus,* even completely agrees with *M. capitatus.* Therefore, I consider the species of Brzeski a junior synonym of *A. capitatus.*

It is strongly queried whether „*Aporcelaimus capitatus*" of Thorne, 1974 is identical with the *capitatus* of Thorne and Swanger. The labial region is extremely narrow and the odontostyle distinctly shorter. I suggest a new species name for it (see *M. angusticollis*).

Metaporcelaimus capitatus can be characterized by the moderately long body, rather thin cuticle, relatively short opening of odontostyle, long eggs, more or less bluntly rounded tail terminus as well as by the number (4–9) of male supplements.

Distribution. Poland and the United States (Utah, Indiana).

Metaporcelaimus coomansi Baqri & Khera, 1975

a) Baqri and Khera, 1975, India *(Aporcelaimellus coomansi):*

Females: L = 1.68–1.90 mm; a = 30–33; b = 3.5–4.1; c = 34–35; V = 53–58 %; c' = 1.5–1.7.

Cuticle distinctly striated, as thick as stylet. Odontostyle 17–18 µm, nearly equal to labial width, aperture 2/3 of its length. Vulva a transverse slit with sclerotized lips. Egg as long as 1.8 body diameters. Female tail 50–55 µm, convex-conoid with slightly dorsally bent tip. The map of the oesophageal gland nuclei is calculated from the original Loof's formula:

D = 49–54 %	AS_1 = 17–18 % AS_2 = 43–47 % PS_1 = 67–70 %
K = 37–43 %	PS_2 = 70–72 %

b) Ahmad, 1995, India *(Aporcelaimellus coomansi):*

Females: L = 1.88–2.27 mm; a = 38–51; b = 4.3–4.8; c = 32–53; V = 55–58 %; c' = 1.4–2.1 (?).

Males: L = 2.21–2.33 mm; a = 45–47; b = 4.6–4.8; c = 53–57; c' = 1.2–1.3.

Cuticle transversely striated, thinner than stylet. Lip region 14–16 µm wide. Odontostyle 16–18 µm, 1.1–1.2 lip region widths long, aperture occupying nearly 2/3 of its length. Spicula 49–52 µm. Ventromedial supplements only two. Female tail 39–59 µm, male tail 41–42 µm, both more or less subdigitate, at male more pointed than at female.

Remarks. This species differs from all others (where males are known) in having merely two supplements. It is very similar to *Metaporcelaimus adoxus* and *M. efficiens.* It only differs from *adoxus* by the somewhat shorter stylet (16–18 µm *vs.* 20–23 µm; it must be noted however that the stylet length according to the figure of *adoxus* is only 18 µm!), and from *efficiens* by the shorter stylet aperture (*vs.* 3/4) and the somewhat longer tail. Unfortunately the males of *efficiens* and *adoxus* are not known, so these species cannot be fully compared with *coomansi.*

Distribution. India.

Metaporcelaimus digitalis (Loos, 1949) comb. n.

a) Loos, 1949, Sri Lanka *(Aporcelaimus digitalis):*

Females: L = 3.04–3.32 mm; a = 33; b =4.1–4.6; c = 47–53; c' = 1.2.

Anterior region markedly tapered. Cuticle about as thick as the stylet. Odontostyle more than 20 µm, as long as or slightly shorter than labial width, aperture occupying 3/4 of its length. Tail 62–65 µm, subdigitate.

b) Thorne, 1974, Nebraska, South Dakota *(Aporcelaimellus sublabiatus):*

Female: L = 4.0 mm; a = 46; b = 4.2; c = 58; V = 56 %; c' = 1.3.

Male: L = 4.0 mm; a = 45; b = 4.5; c = 56.

Cuticle apparently thicker than stylet. Lip region about 1/4 as wide as body width at neck base. Odontostyle 20 µm, nearly as long as labial width, aperture 3/4 of its length. Supplements 8–9, spaced, well before the spicula. Tail with rather blunt tip, slightly subdigitate.

c) Ahmad, 1995, India *(Aporcelaimellus shamimi):*

Females: = L = 2.78–2.81 mm; a = 35–43; b = 3.9–4.6; c = 45–57; V = 59–61 %; c' = 1.3–1.4.

Males: L = 2.52–3.17 mm; a =37–42; b = 4.7–5.3; c = 44–50; c' = 1.1–1.3.

Cuticle with transverse striae, about as thick as stylet. Lip region 20–23 µm wide. Odontostyle 20–21 µm, aperture 2/3 of its length or so. Vulva slit-like with sclerotized lips. Spicula 66–74 µm long. Supplements 6–8, spaced, lying well anterior to spicula. Female tail 49–63 µm, male tail 57–63 µm, both subdigitate with finely rounded tip.

Remarks. *Aporcelaimellus shamimi* completely agrees with *M. digitalis,* so that their identity can hardly be queried.

It seems improbable that *A. sublabiatus* of Thorne, 1974 would be conspecific with the „true" *sublabiatus.* The cuticle is thicker, the odontostyle more slender, the tail shorter (c' = 1.3 *vs.* 1.6–1.9) and the supplements are essentially less in number (6–9 *vs.* 13–16). Thorne's species strongly resembles *M. digitalis;* their identity may be supposed.

Metaporcelaimus digitalis is a comparatively big species with thick cuticle, large stylet aperture, subdigitate tail and moderate number of supplements.

Distribution. India, Sri Lanka and (probably) the United States (Nebraska, South Dakota).

Metaporcelaimus efficiens (Cobb in Thorne & Swanger, 1936) comb. n.

Thorne and Swanger, 1936, Japan *(Dorylaimus efficiens):*

Female: L = 1.8 mm; a = 43; b = 3.6; c = 50; V = 59 %; c' =1.4.

Cuticle about as thick as odontostyle. Odontostyle 16 µm, slender, as thick as 1/4 labial width, equal in length to cephalic diameter, aperture occupying 3/4 of its length. Tail rather bluntly tipped, slightly subdigitate.

Remarks. The short and slender body, the thick cuticle and the large odontostyle aperture may characterize this species. It is close to *M. simplex,* which is also a small species, but the slender figure, thick cuticle and the thinner odontostyle distinguish *efficiens* from that.

Distribution. Japan.

Metaporcelaimus invisus (Tjepkema, Ferris & Ferris, 1971) comb. n.

Tjepkema, Ferris and Ferris, 1971, Indiana *(Aporcelaimellus invisus):*

Females: L = 1.91–2.20 mm; a = 37–47; b = 3.7–5.2; c = 55–69; V = 47–52 %; c' = 1.1–1.2.

Cuticle finely annulated. Labial region 16–18 µm wide. Odontostyle 19–21 µm, aperture 2/3 of its length. Vulval lips sclerotized. Eggs as long as two body diameters. Female tail 31–36 µm, dorsally convex with blunt tip.

Remarks. The American authors noted: *„A. invisus,* like *A. capitatus,* is atypical of *Aporcelaimellus,* may fit as well or better in *Aporcelaimium"* (=

Metaporcelaimus). *Metaporcelaimus invisus* is very similar to *M. simplex* (e.g. both have long eggs), it only differs by a longer and more slender stylet.

Distribution. United States (Indiana).

Metaporcelaimus labiatus (de Man, 1880) comb. n.

a) De Man, 1880, Holland *(Dorylaimus labiatus):*

Females: L = 3.5 mm; a = 50–55; b = 4.5–5.0; c = 45–50; V a little behind mid body; c' = 1.8.

Neck region posterior to the odontostyle with a distinct constriction.

b) Schuurmans Stekhoven, 1951, Zaire *(Dorylaimus labiatus):*

One juvenile, hardly conspecific with de Man's species: as illustrated, the odontostyle is slender with an aperture occupying only 1/3 of its length.

c) Loof, 1961, Holland *(Eudorylaimus labiatus):*

Lectotype female: L = 3.75 mm; a = 48; b = 4.9; c = 54; V = 53 %; c' = 1.7.
Other female: L = 2.49 mm; a = 33; b = 4.4; c = 45; V = 53 %.

Body at proximal end of oesophagus 4–5 times as wide as head. Cuticle much thinner than the stylet. Labial region unusually high, about 1/3 as high as wide. Odontostyle about 14 µm, 1.2 times the labial width, aperture 2/3 of its length. Tail finely rounded, not subdigitate.

d) Loof and Coomans, 1970, Holland, Switzerland *(Aporcelaimium labiatum):*

Cuticle finely transversely striated. Oesophageal gland nuclei:

D = 49–53 %	AS_1 = 13–14 % AS_2 = 40–43 % PS_1 = 70–71 %
K = 30–32 %	PS_2 = 71–72 %

e) Zell, 1986, Germany *(Eudorylaimus labiatus):*

Juvenile: L = 1.62 mm.

Lips spherical and high. Tail finely rounded.

f) Altherr, 1953, Switzerland *(Aporcelaimus conicaudatus):*

Female: L = 3.25 mm; a = 55; b = 5.3; c = 45; V = 51 %; c' = 1.8.

Labial region very high. Cuticle thinner than spear, finely transversally striated. Odontostyle thick, 15 µm long, aperture 7/9 of its length. Tail not subdigitate.

g) Andrássy, 1972, Hungary *(Aporcelaimus conicaudatus):*

Male: L = 3.92 mm; a = 55; b = 5.5; c = 53; c' = 1.7.

Labial region very high, 1/3 as high as wide. Neck with a slight, but distinct constriction posterior to spear. Cuticle somewhat thinner than odontostyle. Odontostyle 16 µm, hardly longer (1.1 times) than labial width, aperture 2/3 of its length. Spicula 70 µm. Supplements 7, spaced, well before the spicula.

h) Altherr, 1974, Germany *(Aporcelaimellus conicaudatus):*

Female: L = 3.25; a = 49; b = 4.7; c = 49; V = 50 %; c' = 1.7.

Odontostyle 15 µm long.

i) Altherr, 1974, Germany *(Aporcelaimus jugeti,* female*):*

Female: L = 4.10 mm; a = 53; b = 5.5; c = 42; V = 55 %; c' = 1.4.

As also supposed by Altherr, the female (but only that!) of this nematode is most probably identical with *conicaudatus (=labiatus)* (see also Andrássy, 2000 a).

Remarks. There is no doubt that Altherr's *conicaudatus* is conspecific with de Man's *labiatus.* The very high lip region, the constriction on the neck, the shape and length of the odontostyle and tail all are of the same kind in both species. Loof (1999) also supposed their identity. Consequently, *Aporcelaimus conicaudatus* is considered a junior synonym of *A. labiatus.*

Loof (1961) gives a good redescription of *A. labiatus* on the basis of the original specimens preserved in the collection of de Man. A little contradiction seems to be found merely in length of the two females measured: one of them appears to be too short for this species. It is therefore not impossible that the smaller animal belonged to an other (similar) species, all the more, de Man collected them in different localities. Luckily, Loof designated the longer female for lectotype.

Metaporcelaimus labiatus can well be characterized by the high head, constricted neck, long (3.2–4.1 mm) and slender body, thin and conspicuously striated cuticle, short odontostyle as compared to body length (14–16 µm, 1.1–1.2 times head diameter), long tail (1.7–1.8 anal diameters) as well as by the number of supplements (7). The value of „K" is very low in this species.

Distribution. Europe: Holland, Germany, Switzerland, Poland, Czech Republic, Hungary, Spain, France, Italy, Belorussia; Asia: Uzbekistan, Russia (Far East).

Metaporcelaimus mombucae Lordello, 1965

a) Lordello, 1965, Brazil *(Metaporcelaimus mombucae):*

Female: L = 1.83 mm; a = 28; b = 4.4; c = 34; V = 56 %; c' = 1.6.

Head 18 µm wide. Cuticle apparently thinner than spear. Odontostyle 17 µm, nearly as long as labial diameter, aperture measuring 2/3 (or longer). Tail

53 µm, slightly concave on ventral side.

b) Baqri and Jairajpuri, 1968, India *(Aporcelaimellus indicus):*

Females: L = 2.40–2.45 mm; a = 49–50; b = 4.7; c = 41–43; V = 57–58 %; c' = 1.8–1.9.

Cuticle thinner than stylet. Odontostyle 16 µm, as long as cephalic diameter, aperture 2/3 of its length. Tail 56–60 µm, conoid, dorsally convex, ventrally slightly concave.

c) Monteiro, 1970, Brazil *(Aporcelaimellus conicaudatus):*

Females: L = 1.99–2.34 mm; a = 32–40; b = 4.2–5.2; c = 30–36; V = 50–55 %.
Males: L = 2.00–2.30 mm; a = 33–42; b = 4.0–4.8; c = 37–45; c' = 1.5.

Head 15–17 µm wide. Odontostyle 14–19 µm, about as long as labial width, aperture 7/10 of its length. Spicula 71–79 µm. Supplements 6–8, spaced, well before the spicula. Tail 50–60 µm, slightly ventrally arcuate.

Remarks. As also Loof (1999) noted, the nematodes of Monteiro are not conspecific with Altherr's *conicaudatus*. They fit however the diagnosis of *mombucae* very well. They were collected in several localities in Brazil; thus, we may suppose, both Lordello and Monteiro have studied one and the same species.

„Aporcelaimus conicaudatus" of Williams (1959) is also very similar to *M. mombucae,* only the longer body (2.6–2.9 mm) distinguishes it from that.

Aporcelaimellus indicus Baqri & Jairajpuri, 1968 is very probably identical with *M. mombucae* (the same shape and length of body, odontostyle and tail). The only difference could be found in the arrangement of the oesophageal nuclei as illustrated in *indicus:* AS_1 and AS_2 nuclei are in pair, very close to each other. Such a situation is however quite unusual in aporcelaimoid nematodes, so that these nuclei were presumably misidentified.

In length of the odontostyle and its aperture as well as in number of the supplements, *Metaporcelaimus mombucae* is similar to *M. labiatus.* The Brazilian species is however shorter (1.8–2.4 vs. 3.2–4.1 mm), its labial region lower and the neck does not show any constriction.

Distribution. India, Brazil.

Metaporcelaimus oceanicus nom. n.

a) Williams, 1959, Mauritius *(Aporcelaimus conicaudatus):*

Females: L = 2.6–2.9 mm; a = 35–43; b = 3.7–4.5; c = 37–43; V = 51–55 %; c = 1.4.

Anterior region strongly tapering. Cuticle with distinctannulation, about as thick as stylet. Odontostyle 16 µm, as long as lip region width, aperture occupying 2/3 of its length. Tail dorsally convex-conoid with rounded tip.

b) Heyns, 1995, Comores Islands *(Aporcelaimellus conicaudatus):*

Females: L = 2.85–3.12 mm; a = 33–34; b = 3.8–4.1; c = 39–51; V = 54–55 %; c' = 1.4–1.8.

Labial region 18–19 µm wide. Cuticle very finely annulated, as thick as stylet. Odontostyle 17–18.5 µm, aperture about 2/3 of its length. Vulva not sclerotized. Tail 61–74 µm long, conoid with rounded terminus.

Remarks. Heyns underlined that his specimens were in complete agreement with those of Williams. The comparatively close localities in the western Indian Ocean also strengthen their identity.

In the position of the oesophageal gland nuclei there is some contradiction. In one of his two specimens, Heyns illustrated a large nucleus quite close to AS_2; he regarded it to be „AS_1", but he could not give the outlet of this „gland". He said however: „In both specimens there is an additional outlet in the lumen about 57–59 µm behind the dorsal gland opening, and in specimen *b* there is an indication of a gland cell associated with this outlet." It is almost certain that this latter opening and „indication" close to D meant the true position of AS_1, and that the „nucleus" thought to be the first anterior sublateral gland was merely a nucleus-like granule.

Among the longer species of the genus, *Metaporcelaimus oceanicus* is characterized in having a rather short odontostyle, a medium long tail and a non-sclerotized vulva.

Distribution. Western Indian Ocean: Mauritius and the Comores.

Metaporcelaimus romanicus (Popovici, 1978) comb. n.
(Fig. 3 A–E)

a) Popovici, 1978, Rumania *(Aporcelaimus romanicus):*

Females: L = 2.93–3.56 mm; a = 38–41; b = 4.0–4.6; c = 56–69; V = 49–53 %; c' = 1.0–1.2.

Males: L =2.75–3.42 mm; a = 36–47; b = 3.9–4.9; c = 54–71; c' = 1.0–1.2.

Head 16 µm wide, as wide as 1/5 body width at neck base, about 1/3 times as high as wide. Cuticle nearly as thick as spear. Odontostyle 17–20 µm, 1.2–1.3 times the head diameter, aperture 2/3 of its length. Spicula 75–92 µm. Supplements 10–12, spaced, posterior one or two lying within the range of spicula. Tail with relatively blunt tip, subdigitate.

b) Present specimens, two paratypes kindly sent by Dr. Popovici, Rumania *(Aporcelaimus romanicus):*

Paratype males: L = 2.85–3.28 mm; a = 30–46; b = 4.3–4.5; c = 62–65; c' = 1.1–1.2.

Labial region 14–16 µm wide, 1/4 or 1/5 of body width at base of neck. Odontostyle 19–21 µm, distinctly longer than labial diameter; aperture 2/3 of stylet length. Spicula 74–79 µm. Supplements 11 in both males, posterior two of them in range of spicula. Male tail 45–46 µm long.

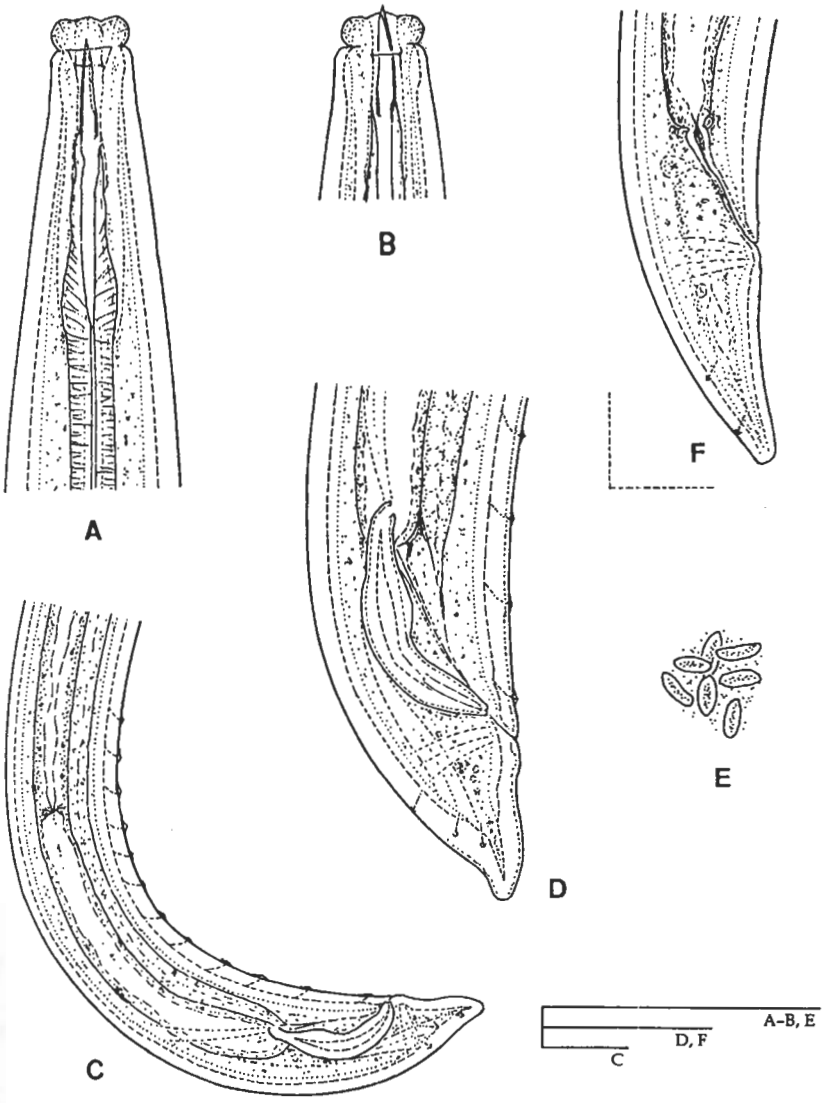


Fig. 3. A–E. *Metaporcelaimus romanicus* (Popovici, 1978) comb. n. – a typical representative of the genus. Paratype specimens from Rumania. A–B: anterior end of two males; C: posterior end of a male; D: posterior end of another male; E: spermatozoa. – Fig. 3 F. *Metaporcelaimus mombucae* Lordello, 1965 from India. Female tail. (Scale bars 50 µm each)

Remarks. The two paratypes I could studied correspond in every respect to the original description.

Metaporcelaimus romanicus is a well recognizable nematode: it differs from every species of the genus in the arrangement of supplements; this is the single species within the group that has 1–2 supplements at latitude of the spicula. It is a large-sized representative of the genus, with a comparatively short tail and high number of supplements (only *M. sublabiatus* has more supplements, 13–16).

Distribution. Rumania.

Metaporcelaimus simplex (Thorne & Swanger, 1936) comb. n.

a) Thorne and Swanger, 1936, Utah, Jamaica *(Dorylaimus simplex):*

Female: L = 1.7 mm; a = 24; b = 3.9; c = 32; V = 54 %, c' = 1.2.
Male: L = 1.7 mm; a = 23; b = 3.7; c = 32.

Cuticle much thinner than spear. Odontostyle thick, hardly longer than labial width, aperture 3/4 of its length. Eggs almost twice as long as body width. Supplements only 4, separate, far before the spicula. Tail short and rather blunt on tip.

b) Tjepkema, Ferris and Ferris, 1971, Utah *(Aporcelaimellus simplex):*

Females from Thorne's collection: L = 1.88–2.40 mm; a = 29–34; b = 4.1–4.7; c = 38–57; V = 48–54 %; c' = 1.0–1.4.

Cuticle faintly annulated, much thinner than stylet. Labial width 20 µm. Odontostyle 17–20 µm, aperture 3/4 of stylet length. Vulval lips sclerotized. At a time, females with one egg being as long as 1.3–1.5 body diameters. Female tail 35–57 µm.

c) Loof and Coomans, 1970, Holland, France, Italy, California *(Aporcelaimellus simplex):*

Cuticle with fine transverse striae. Oesophageal gland nuclei:

D = 54–58 %	AS_1 = 19–21 % AS_2 = 41–47 % PS_1 = 67–70 %
K = 44–48 %	PS_2 = 70–74 %

c) Heyns, 1971, South Africa (*Paraxonchium* sp. from Makatini Flats):

Cuticle thinner than spear. Odontostyle thick, hardly longer than labial width, aperture more than 2/3 of its length. Tail about 1.3 anal diameters long, bluntly rounded.

Remarks. No doubt, the latter nematode is a *Metaporcelaimus* as well. Since Heyns did not give any morphometric data, it is not possible to realise his species. It resembles *M. simplex.*

The short body, thin cuticle, thick odontostyle, long eggs and short tail may characterize *Metaporcelaimus simplex*. In addition, it shows the second lowest number of supplements (4) within the genus.

Distribution. Europe: Holland, France, Italy; America: United States (Utah, California), Jamaica; and, maybe, Africa: South Africa.

Metaporcelaimus sublabiatus (Thorne & Swanger, 1936) comb. n.

a) Thorne and Swanger, 1936, Utah *(Dorylaimus sublabiatus):*

Female: L = 3.2 mm; a = 33; b = 4.5; c = 56; V = 52 %; c' = 1.7–1.8.
Male: L = 3.1 mm; a = 43; b = 4.3; c = 52.

Head moderately high, about 1/4 as high as wide. Cuticle thinner than stylet. Odontostyle massive, about 20 µm, nearly equal in length to the labial diameter, aperture occupying 3/4 (2/3?) of its length. Supplements 13–16, separate, all before the spicula. Tail narrowly rounded on tip, slightly subdigitate.

b) Andrássy, 2000 a, Alaska *(Aporcelaimus conicaudatus):*

Females: L = 3.23–3.70 mm; a = 38–50; b = 4.4–5.2; c = 47–50; V = 48–51 %; c' = 1.6–1.9.

Cuticle about as thick as odontostyle. Labial region 15–16 µm wide, 1/5–1/6 of body width at posterior end of oesophagus. Odontostyle 20–23 µm, 1.3–1.4 head diameters, aperture 2/3 of its length. Tail tip narrowly rounded, mostly slightly subdigitate. Oesophageal gland nuclei:

D = 50–51 %	AS_1 = 21–24 % AS_2 = 45–49 % PS_1 = 74–76 %
K = 47–50 %	PS_2 = 75–78 %

Remarks. The Alaskan specimens seem to belong more to *M. sublabiatus* than to *M. labiatus* (syn. *Aporcelaimus conicaudatus*) as I supposed. The labial region is not so very high and the odontostyle is longer (20–23 µm, 1.3–1.4 labial diameters *vs.* 14–16 µm, 1.1–1.2 labial diameters).

Metaporcelaimus sublabiatus is distinctive because of the combination of its morphological features: long body, comparatively long odontostyle, long tail (1.6–1.9 anal diameters). In addition, it has the highest number of supplements within the genus (13–16).

Distribution. Europe: Spain, Poland; America: United States (Utah, Alaska).

1 Aperture 1/2 of stylet length 2
– Aperture 2/3 to 3/4 of stylet length 3

2 Labial region extremely narrow, 1/8 body width at neck base; odontostyle 14 µm. **angusticollis** nom. n.
– Labial region not so narrow, 1/5 body width at neck base; odontostyle 20–23 µm . **capitatus** (Thorne & Swanger)

3 Body smaller, 1.6 to 2.3 mm 4
– Body bigger, 3.0 to 4.1 mm 9

4 Cuticle as thick as odontostyle (very closely related species) 5
– Cuticle conspicuously thinner than odontostyle 7

5 Odontostyle 20–23 µm long ..... **adoxus** (Tjepkema, Ferris & Ferris)
– Odontostyle 16–18 µm long 6

6 Aperture 2/3 of stylet length ..... **coomansi** (Baqri & Khera)
– Aperture 3/4 of stylet length ..... **efficiens** (Cobb in Thorne & Swanger)

7 Tail longer, 1.5–1.9 anal diameters, slightly concave on ventral side ..... **mombucae** Lordello
– Tail shorter, 1.1–1.2 anal diameters, straight on ventral side 8

8 Odontostyle slender, distinctly longer than labial diameter ..... **invisus** (Tjepkema, Ferris & Ferris)
– Odontostyle robust , as long as or shorter than labial diameter ..... **simplex** (Thorne & Swanger)

9 One or two supplements within range of spicula ..... **romanicus** (Popovici)
– No supplement within range of spicula 10

10 Lips spherical and very high; odontostyle 14–16 µm..... **labiatus** (de Man)
– Lips somewhat depressed, moderately high; odontostyle 20–23 µm 12

12 Tail shorter, 1.2–1.4 anal diameters; supplements 6–9 ..... **digitalis** (Loos)
– Tail longer, 1.6–1.9 anal diameters; supplements 13–16..... **sublabiatus** (Thorne & Swanger)

REFERENCES

1. AHMAD, W. (1995): Studies on the genus Aporcelaimellus Heyns, 1965 (Dorylaimida: Aporcelaimidae) from India. – Fundam. Appl. Nematol., 18: 219–225.
2. ALTHERR, E. (1953): Les nématodes du sol du Jura vaudois et français. – Bull. Soc. Vaud. Sci. Nat., 65: 429–460.
3. ALTHERR, E. (1954): Les nématodes des étangs de Bavois (Vaud). – Bull. Soc. Vaud. Sci. Nat., 66: 33–46.
4. ALTHERR, E. (1965): La faune des sables submergés des rives du Rhin près de Krefeld. Nématodes. – Gewässer und Abwässer, Düsseldorf, 39/40: 80–101.
5. ALTHERR, E. (1968): Nématodes de la nappe phréatique du réseau fluvial de la Saale (Thuringe) et psammique du Lac Stechlin (Brandenbourg du nord). – Limnologica, 6: 247–320.
6. ALTHERR, E. (1974): Nématodes de la nappe phréatique du réseau de la Saale (Thuringe), II. – Limnologica, 9: 81–132.
7. ANDERSON, R. V. (1966): Observations on the nervous system of Aporcelaimus amphidysis n. sp. (Nematoda: Dorylaimoidea). – Canad. Journ. Zool., 44: 815–820.
8. ANDRÁSSY, I. (1962): Wiederfund einiger seltener Nematoden-Arten aus der Superfamilia Dorylaimoidea. – Ann. Univ. Budapest, Sect. Biol., 5: 3–11.
9. ANDRÁSSY, I. (2000 a): Some species of the genus Aporcelaimus Thorne et Swanger, 1936 (Nematoda: Dorylaimida) from Alaska. – Ann. Zool. PAN, Warszawa, 50: 151–164.
10. ANDRÁSSY, I. (2000 b): Four large-sized species of the family Aporcelaimidae (Nematoda, Dorylaimoida) with proposal of a new genus, Epacrolaimus gen. n. – Opusc. Zool. Budapest, 32: 3–26.
11. BAQRI, Q. H. & COOMANS, A. (1973): A taxonomic revision of the nematode species described by S. Stekhoven & Teunissen (1938) and S. Stekhoven (1951) from National Virunga Park (Zaire Republic). 1. Dorylaimidae, Aporcelaimidae and Longidoridae. – In: Explor. Parc Nat. Virunga, 1: 3–57.
12. BAQRI, Q. & JAIRAJPURI, M. S. (1968): On six new species of Dorylaimida (Nematoda). – Journ. Helminthol., 42: 243–256.
13. BAQRI, Q. & KHERA, S. (1975): Two new species of the genus Aporcelaimellus Heyns, 1965 with some remarks on the relationship of Aporcelaimellus with Eudorylaimus Andrássy, 1959 (Dorylaimoidea: Nematoda). – Dr. B. S. Chauhan Comm. Vol.: 171–180.
14. BONGERS, T. (1988): De nematoden van Nederland. Een identificatietabel voor de in Nederland aangetroffen zoetwater- en bodembewonende nematoden. – Utrecht, pp. 408.
15. BOTHA, A. & HEYNS, J. (1990): Aporcelaimidae (Nematoda: Dorylaimida) from the Kruger National Park. – Koedoe, 33: 27–46.
16. BRZESKI, M. (1964): Einige neue und seltene Nematoden aus der Überfamilie Dorylaimoidea. I. Unterfamilie Dorylaiminae (Nematoda, Dorylaimidae). – Ann. Zool. PAN, Warszawa, 22: 1–22.
17. COBB, N. A. (1893): Nematodes, mostly Australian and Fijian. – Macleay Mem. Vol. Linn. Soc. N. South Wales: 252–308.
18. COOMANS, A. (1966): Some nematodes from Congo. – Revue Zool. Bot. Afr., 74: 287–312.
19. DITLEVSEN, H. (1911): Danish freeliving nematodes. – Vidensk. Medd. Dansk. Naturh. Foren. København, 63: 213–256.

20. GAGARIN, V. G. (1992): The freeliving fresh-water nematodes of the Soviet Union. (In Russian.) - Sankt-Peterburg, pp. 152.

21. GOODEY, J. B. (1963): Soil and freshwater nematodes. - London, pp. 544.

22. GOODEY, T. (1951): Soil and freshwater nematodes - a monograph. - London, pp. 390.

23. HEYNS, J. (1965): On the morphology and taxonomy of the Aporcelaimidae, a new family of dorylaimoid nematodes. - Entomol. Mem. Dep. Agric. Techn. Serv., Pretoria, 10: 1-51.

24. HEYNS, J. (1971): A guide to the plant and soil nematodes of South Africa. - Cape Town, pp. 233.

25. HEYNS, J. (1989): Redescription of Paraxonchium laetificans (Andrássy, 1956) and P. monohystera (Brzeski, 1964) (Nematoda: Dorylaimida). - Nematologica, 34: 302-313.

26. HEYNS, J. (1995): Three Dorylaimoidea species from islands in the western Indian Ocean. - Nematologica, 41: 422-434.

27. ISATULLAEVA, R. I. (1967): New nematode species on the ornamental plants in Kazakhstan. (In Russian.) - Izvest. Akad. Nauk Kazakhs. SSR, 2: 46-50.

28. JAIRAJPURI, M. S. & AHMAD, W. (1992): Dorylaimida. Free-living, predaceous and plant-parasitic nematodes. - New Delhi - Bombay - Calcutta, pp. 458.

29. LOOF, P. A. A. (1961): The nematode collection of Dr. J. G. de Man. - Meded. Lab. Phytopath., 190: 169-254.

30. LOOF, P. A. A. (1999): Nematoda, Adenophorea (Dorylaimida). - In: Brauer, A. (ed.): Süsswasserfauna von Mitteleuropa, 4/2-2, pp. 264.

31. LOOF, P. A. A. & COOMANS, A. (1970): On the development and location of the oesophageal gland nuclei in the Dorylaimina. - Proc. IX. Int. Nematol. Symp. Warsaw: 79-161.

32. LOOF, P. A. A. & HEYNS, J. (1997): Aporcelaimus Thorne & Swanger, 1936 (Nematoda): proposed designation of Dorylaimus superbus de Man, 1880 as the type species. - Bull. Zool. Nomenclat., 54: 80-82.

33. LOOF, P. A. A., JAIRAJPURI, M. S. & AHMAD, W. (1995): Corrections and additions to: Jairajpuri and Ahmad: Dorylaimida. - Fundam. Appl. Nematol., 18: 393-402.

34. LOOS, C. (1949): Notes on free-living and plant-parasitic nematodes of Ceylon. No. 6. - Journ. Zool. Soc. India, 1: 30-36.

35. LORDELLO, L. G. E. (1955): Three new soil nematodes from Piracicaba (State of S. Paulo), with a key to the species of the genus „Aporcelaimus" (Dorylaimidae). - Rev. Brasil. Biol., 15: 211-218.

36. LORDELLO, L. G. E. (1965): Contribution to the knowledge of the Brazilian nematodes of the family Dorylaimidae. (In Portuguese.) - Thesis No. 9, Esc. Sup. Agric. „Luiz de Queiroz" Univ. São Paulo, Piracicaba, pp. 68.

37. DE MAN, J. G. (1880): Die einheimischen, frei in der reinen Erde und im süssen Wasser lebenden Nematoden. Vorläufiger Bericht und descriptivsystematischer Theil. - Tijdschr. Nederl. Dierk. Vereen., 5: 1-104.

38. DE MAN, J. G. (1884): Die frei in der reinen Erde und im süssen Wasser lebenden Nematoden der niederländischen Fauna. Eine systematische-faunistische Monographie. - Leiden, pp. 206 + 34 pls.

39. MEYL, A. H. (1961): Die freilebenden Erd- und Süsswassernematoden (Fadenwürmer). - In: Die Tierwelt Mitteleuropas, Leipzig, pp. 164 + 54 tabs.

40. MICOLETZKY, H. (1922): Die freilebenden Erd-Nematoden mit besonderer Berücksichtigung der Steiermark und der Bukowina, zugleich mit einer Revision sämtlicher nicht mariner, freilebender Nematoden in Form von Genus-Beschreibungen und Bestimmungsschlüsseln. – Arch. Naturg., Abt. A, 87, pp. 650.

41. MONTEIRO, A. R. (1970): Dorylaimoidea de cafezais paulistas (Nemata, Dorylaimida). – Ph. D. Thesis, Univ. São Paulo, pp. 137 + 5 pls.

42. POPOVICI, I. (1978): New nematode species (Dorylaimoidea) from Rumania. – Nematologica, 24: 404–411.

43. RADU, V. G. & POPOVICI, I. (1967): Contributions to the study of free soil Nematoda (II). (In Rumanian.) – Studia Univ. Babeş-Bolyai, Ser. Biol., 2: 87–91.

44. SCHUURMANS STEKHOVEN, J. H. (1951): Nématodes saprozoaires et libres du Congo Belge. – Mém. Inst Roy. Sci. Nat. Belg., 2: 3–79.

45. SCHUURMANS STEKHOVEN, J. H. & TEUNISSEN, R. J. H. (1938): Nématodes libres terrestres. – In: Exploration du Parc National Albert, Mission G. F. de Witte (1933–1935), Brussels, 22: 1–229.

46. STEINER, G. (1925): On some plant parasitic nemas and related forms. – Journ. Agric. Res. Washington, 28: 1059–1066 + 4 pls.

47. TARJAN, A. C. & HOPPER, B. E. (1974): Nomenclatorial compilation of plant and soil nematodes. – DeLeon Springs, pp. 419.

48. THORNE, G. (1937): Notes on free-living and plant-parasitic nematodes. – Proc. Helminthol. Soc. Washington, 4: 16–18.

49. THORNE, G. (1939): A monograph of the nematodes of the superfamily Dorylaimoidea. – Capita Zool., 8: 1–261.

50. THORNE, G. (1974): Nematodes of the Northern Great Plains. Part II. Dorylaimoidea in part (Nemata: Adenophorea). - Techn. Bull. Agric. Exper. Stat. S. Dakota Univ., Brookings, 41: 3–120.

51. THORNE, G. & SWANGER, H. H. (1936): A monograph of the nematode genera Dorylaimus Dujardin, Aporcelaimus n. g., Dorylaimoides n. g. and Pungentus n. g. – Capita Zool., 6, pp. 223 + 31 pls.

52. TJEPKEMA, J. P., FERRIS, V. R. & FERRIS, J. M. (1971): Review of the genus Aporcelaimellus Heyns, 1965 and six species groups of the genus Eudorylaimus Andrássy, 1959 (Nematoda: Dorylaimida). – Res. Bull. Agric. Exper. Stat. Purdue Univ., 882: 1–52.

53. WILLIAMS, J. R. (1959): Studies on the nematode soil fauna of sugar cane fields in Mauritius. 3. Dorylaimidae (Dorylaimoidea, Enoplida). – Occ. Pap. Mauritius Sugar Res. Inst., 3: 1–28.

54. ZELL, H. (1986): Nematoden eines Buchenwaldbodens. 6. Die Dorylaimen (Nematoda, Dorylaimida). – Carolinea, 44: 91–118.

Water bodies in the Gemenc floodplain of the Danube, Hungary
(A theoretical basis for their typology)

By
G. GUTI*

Abstract. The 30 km long section of the Danube in the Gemenc region has a large inundated floodplain. A drying-out process was observed in this moderately regulated stretch in the 20th century due to the deepening of the riverbed. Technical interventions are necessary for the restoration of the fluvial hydrosystem and the classification of the aquatic biotopes would be an important guideline for the development of the management strategy. This paper reviews the most significant human impacts on the Gemenc floodplain and outlines a typological analysis of the hydrosystem. The study of the fish fauna is one of the useful tools for the ecological description of the different water body types.

The Gemenc floodplain is one of the last remaining extensive inundated floodplain of the Danube. In the 19th century river regulation works resulted in the isolation of floodplains from the main stream, cutting through meanders and straightening of the riverbed. Reduction in river length accelerated the passage of floods, while low water stages became more common, with lower levels. Thus, river regimes became more extreme. Another consequence of the river regulations is the deepening of the riverbed, causing the continuous fall in water levels over large areas, and the drying-out process of floodplain water bodies during the 20th century. Drastic aquatic habitat changes were the main cause of the fish decline, which indicates a decrease in biodiversity.

The remaining fragments and elements of the original Danubian floodplains have geological, botanical, zoological and scenic values at the beginning of the 21st century, but technical interventions must be taken now in order to save and restore them. The ecological management of the river ecosystem must consider the different biotopes occurring within the floodplain and their ecological functions. (Individual units of well defined communities occur almost always among similar environmental circumstances, thus we reserve the term „biotope" for the habitat of biotic communities [Udvardy, 1959] in this study.) The typology of floodplain

*Dr. Gábor Guti, MTA ÖBKI Magyar Dunakutató Állomás (Institute of Ecology and Botany of the Hungarian Academy of Sciences), 2131 Göd, Jávorka Sándor u. 14, Hungary.

water bodies would be essential in the development of an effective conservation strategy. The present paper proposes a theoretical basis for the typology of water bodies in the Gemenc floodplain with the integration of geomorphological, hydrological and ecological aspects.

The hydrosystem of the Gemenc floodplain

The natural system

The Gemenc region of the Danube (r.km 1497-1467) is covering an area of 178 km², so it is one of the largest inundated floodplains in Europe. It is situated in the south-western margin of the Great Hungarian Plain, along an irregularly meandering lowland section of the Danube. The main riverbed is characterized with low flow velocity and slow lateral movement. Its sediments consists of sand or silt. Cut-offs often occur, and the channel stability allows the complete formation of oxbow lakes, even as whole development of ecological successions in the extensive floodplain.

In the range of the Gemenc floodplain, the gradient of the Danube is 5 cm km^{-1}, the mean discharge is 2260 $m^3 s^{-1}$, and its extreme values were 470 $m^3 s^{-1}$ and 8700 $m^3 s^{-1}$ (Bulla, 1962). The difference between the lowest and the highest water level is usually 5-7 m, but the maximum difference reaches 9-10 m. Due to the melting of the snow-cover and ice-flows of the Alps, the flood regime has a glacial character. The low-water winter periods are generally followed by smaller floods ("icy-flood") in March and April. Larger floods ("green-flood") usually occur in May and June. Low waters are typical in October.

The Gemenc region includes aquatic, semi-aquatic and terrestrial biotopes within the floodplain in lateral dimension that are interconnected with the lotic environment of the river. This fluvial hydrosystem has three main components (Welcomme, 1979, 1983, 1985):

1) The *lotic component* is represented by the permanently flowing main riverbed.

2) The *floodplain*, which is seasonally inundated. It can be divided into lower and higher regions. The lower one is 4-5 m and the higher one is 7-10 m above the 0 point of the water-gauge at Baja. The lower region is flooded annually (Pécsi, 1959).

3) The *lentic components* are represented by a variety of standing waters (permanent or semi-permanent standing waters are in residual former channels, backwaters, oxbows, etc.), which remain in the floodplain during the dry season. These water bodies expand and contract according to the annual flood cycle. During the highest floods they tend to merge into a continuous water cover over the whole floodplain. The permanent standing waters of the floodplain are generally shallow, rarely exceeding 4 m in depth and may be in connection with the river. Aquatic habitats on the floodplain

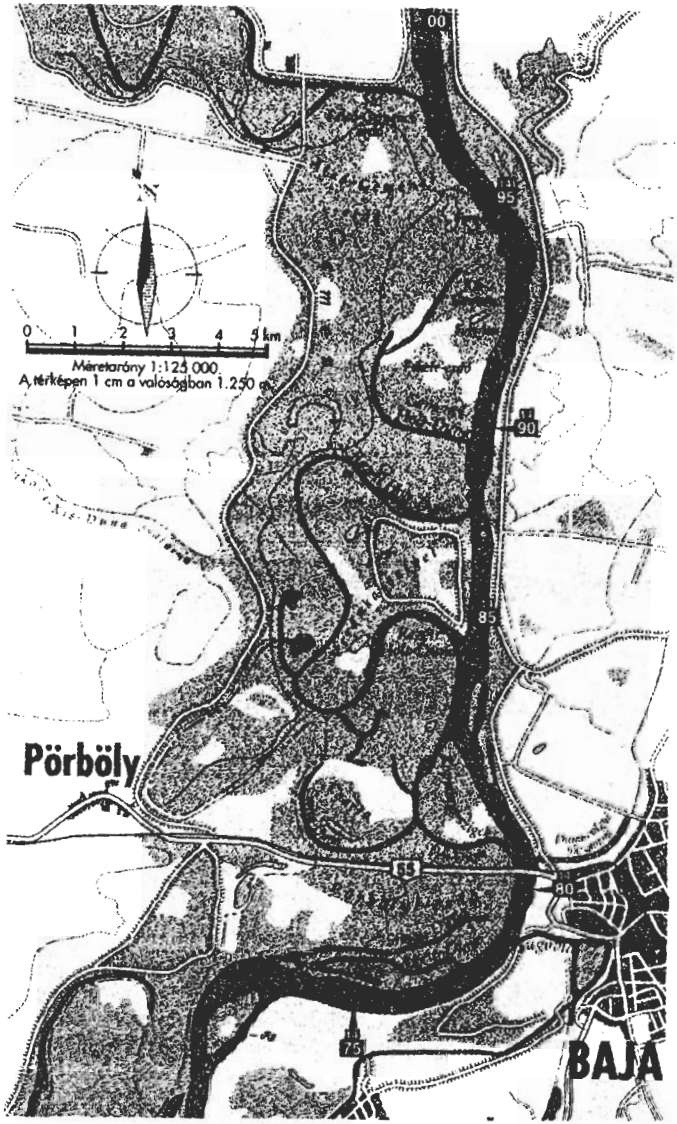


Fig. 1. Map of the Gemenc floodplain in our age

loose water by evaporation and infiltration throughout the dry season. This results in the shrinking and eventual drying out of many water bodies.

Human impacts

The management history of the Danubian floodplains started several centuries ago. During the 3rd century Romans built boat-towing roads along the right bank of the Middle Danube (Balon, 1967; Rakonczay, 1987). In the Middle Ages the Danube valley was an outstanding economical axis of Hungary. Systematic agricultural activity started in the 9th century on the floodplains. The most important human impacts, which changed the hydrological condition of the Gemenc floodplain, were the creation of drainage canals (fok-system) and later the river regulations for flood control and navigation.

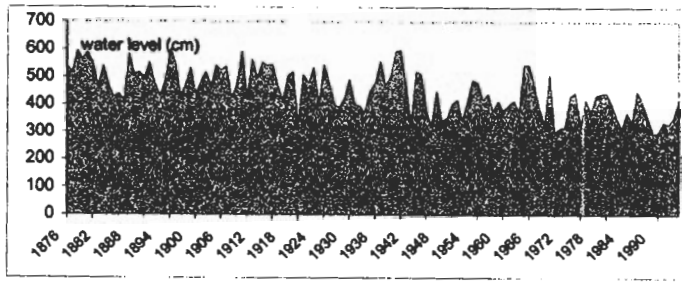


Fig. 2. Decreasing trend of the annual water level of the Danube at Baja between 1876 and 1995

The inhabitants of the Danube valley developed a high-level floodplain farming in the Middle Ages. The ancient "fok"-system consisted of small drainage canals and the artificial inlet, "fok" in Hungarian, opening the way for the water into the floodplain through natural levees. The fok-systems of the Gemenc floodplain connected the oxbow lakes to the Danube and to each other. Through the canals, the oxbow lakes and their connected areas were frequently supplied with water from the river for the benefit of fishery and extensive agriculture. In the 16th and 17th century the fok-system nodded to its fall and the advance of the floodplain framing broke off because the small settlements on the Danubian floodplain became depopulated during the 150 years of Turkish conquest (Andrásfalvy, 1973).

The economic development has demanded the regulation of the Danube stretch between Dunaföldvár and Mohács (r.km 1560-1447) since the 18th century. In the Gemenc region the regulation of the Sió-Sárvíz hydrosystem

(a right side tributary of the Danube) was the most considerable attempt of water management in the 18th century. Inhabitants, who had interest in the traditional floodplain farming, revolted against these works. Overall river regulations started in the 19th century. Their main aims were flood control and improved navigation. River regulation involved construction of dikes along the river thereby inundated floodplains were reduced to less than 10% of heir original area. The middle and low water regulations resulted in the straightening and shortening of watercourses, cutting through meanders and isolating them from the riverbed. The most important steps of these operations were the following in chronological order (Károlyi, 1973):

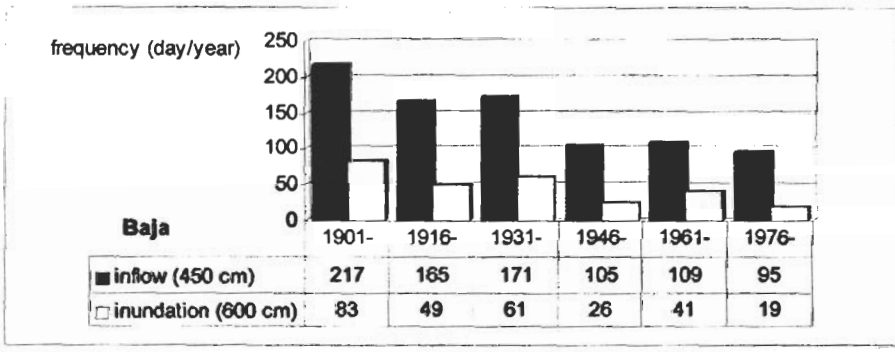
- the cutting through of four meanders between Fadd (r.km 1507) and Mohács (r.km 1447), which shortened the Danube bed by 33.4 km in 1820 and 1821;
- a regular steamboat service started between Budapest and Baja in 1833;
- the cutting through a 30 km long meander at Tolna (r.km 1504) with a 7 km long cut-off between 1843 and 1852;
- the excavation of a 4 km long channel from the Sió-Sárvíz river to the Danube in 1854 and 1855, while the original tributary at Báta (r.km 1465) was closed up by a sluice and a new tributary was created at Tolna (r.km 1497), thereby the 50 km long lower section of the Sió-Sárvíz was by-passed;
- flood control dikes were built along the Danube between Szekszárd and Báta from 1870 to 1872, however an extensive inundated area is left in the Gemenc floodplain;
- the cutting through of three meanders in the Gemenc area between 1893 and 1898 (the Grébeci-Danube at Sükösd, the Rezéti-Danube at Érsekcsanád and the Vén-Danube at Koppány), which shortened the Danube bed by 18 km;
- the excavation of a drainage ditch network in the flood free area of the right side floodplain from 1896 to 1930 making the 50 km long by-passed bed of the Sió-Sárvíz river the main channel of the new 145 km long ditch network;
- the low water regulation of the Danube stretch between Bogyiszló (r.km 1502) and the outlet of the Vajas-fok (r.km 1486) from 1905 to 1914;
- the closing up the Kádár side arm in 1946;
- the low water regulation works for better navigability since the end of the 1960s.

The river regulation works have had a number of indirect effects on the hydrology and channel morphology:

- There are 23 cut-off meanders along the Dunaföldvár–Mohács Danube stretch (r.km 1560-1447). The shortening of the riverbed was 77 km that is

41% and the gradient increased from 5 cm km^{-1} to 8 cm km^{-1} after channelization (Károlyi, 1973; IUCN, 1995).

- River length reduction accelerated the passage of flood peaks, while low water stages with lower levels became more common, than before the river regulation works. The river regime became more extreme. Flow velocity increased and floods became higher.
- River channelization increased channel erosion, which led to a deepening of the main riverbed as shown by a 1.5 m dropping of low water levels. Riverbed degradation restricted the connectivity of the floodplain water bodies to the main river channel, which led to a decreasing water supply and an increasing silt deposition in the lentic components of the hydrosystem. Two important examples are the following:



Baja	1901-	1916-	1931-	1946-	1961-	1976-
■ inflow (450 cm)	217	165	171	105	109	95
□ inundation (600 cm)	83	49	61	26	41	19

Fig. 3. Frequency of the 450 cm and 600 cm water levels of the Danube at Baja during the 20th century

a) The minimal water level that provides an inflow to the side arms of the Gemenc floodplain is 450 cm at Baja (r.km 1479). At the beginning of the 20th century, the frequency of the water level above 450 cm was 217 days in a year. At the end of the century this frequency decreased by 56%, that is 95 days in a year (Fig. 3), even if the discharge of the Danube does not have trend line in the 20th century.

b) The dropping of the water level affected floodplain inundation, too. The Gemenc floodplain is inundated at a water level higher than 600 cm at Baja. At the beginning of the 20th century, the frequency of the 600 cm water level was 83 days in a year. By the end of the century this time decreased by 77%, that is 19 flooded days in a year (Guti and Keresztessy, 1997).

After the overall river regulation the economic development has changed several basic characteristics of the Gemenc region. The forestry practices have unfavourable effects on the natural floodplain ecosystems. The replacement of the natural forest with hybrid poplars and other fast-growing exotic trees causes a biodiversity decrease. A related problem is the age distribution of the trees which is becoming more uniform, 20 years old stock is dominating while trees of 80 to 90 years have became rare. Recreational activities have led to uncontrolled and illegal building of weekend cottages since the 1970s. From an ecological point of view the related problems are mostly local (rubbish dumping, wastewater discharge, visual hindrance). The Gemenc floodplain was qualified as a region of national importance and its protection was declared in 1977. It has been incorporated into the Danube-Drava National Park since its foundation in 1996.

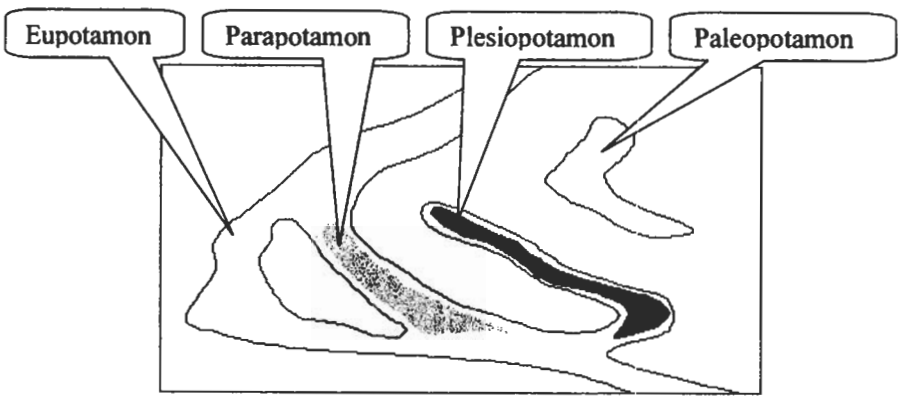


Fig. 4. Schematic representation of different functional sets of floodplain rivers

Typology of the floodplain waters

One of the most extensive classification systems of the water bodies of the floodplain rivers was provided by Roux et al. (1982), which was based on geomorphological, hydrological, and ecological analysis. Their system subdivides the water bodies into four main types or "functional sets" (Holčik et al., 1989; Amoros, 1991):

1) Eupotamon: The main channel of the river and its sidearms have a permanent flow. These lotic channels are not considered as floodplain water bodies. Their bottom is composed of stones, gravel and coarse sand. Macrophytes are absent or very scarce.

2) Parapotamon. Sidearms permanently connected to the main channel at their downstream end. Semi-stagnant floodplain waters that cut off and silted up at their upstream ends. Their flow is fed by surface and ground water. The bottom is composed of gravel mixed with sand and silt. Macrophytes are scarce.

3) Plesiopotamon. Permanent or temporary standing water bodies in the floodplain that were formerly channels or sidearms with no permanent and direct connection to the main channel of the river. They are connected during high water levels and highly influenced by the discharge of the river. The bottom consists of silt and clay. Macrophytes grow densely.

4) Paleopotamon. Permanent standing water bodies in the floodplain that were former anatomised channels or meanders (oxbow lakes), with no direct connection to the river. These water bodies are larger and deeper than the plesiopotamon, and mildly influenced by river discharge. The bottom consists of silt and clay. Macrophytes grow very densely.

In reality, a temporal continuum exists since ecological succession develop from eupotamon towards parapotamon and then to plesiopotamon. Some transitional cases between plesiopotamon and paleopotamon can also occur in relation to their geographical location and their hydrological function (Amoros et al., 1987).

The geomorphological stability of the meandering Gemenc area of the Danube allowed the complete formation of oxbow lakes (Pécsi, 1959), therefore the whole development of ecological succession (several development stages of ecosystems from juvenile to mature) occurred here before the river regulations. The transition of a cut-off meander to terrestrial biotopes requires 2-3 centuries. However, such biotope modifications are combined with ecological successions. Their progress differ according to the predominance of allogenic processes (general lowering of the water-table, deposition of mineral sediments, etc.) or autogenic process (colonization, vegetation dynamics, eutrophication, etc.). Human interventions may accelerate or reduce the rate of ecological succession by the modification of the fluvial dynamics (Amoros et al., 1987).

There has been no attempt to identify the functional sets and classify the aquatic biotopes within the floodplain in the Gemenc region. The typology of the floodplain water bodies must incorporate geomorphological, hydrological, hydrobiological and historical informations, as well as expedient examinations need to amplify the incomplete store of our knowledge.

Typological analysis uses functional describers as research tools. A functional describer is a component of either the biotope, or the biocenosis that provides information about the type of development stages of the ecosystem. Two elements of the ecosystem are particularly useful as functional describers: sedimentological and biotic characteristics. The granulometric pattern describes not only the sedimentology of the fluvial deposit but also the function of a biotope type. Living organisms and their

population structure provides information about present and previous ecological conditions. Indicator taxa or ecological guilds can be used as functional describers (Amoros et al., 1987).

Fish fauna as a functional describer of the floodplain hydrosystem

The history of the fish fauna surveys of the Danube in the Gemenc floodplain goes back to the end of 1950s. There are 30 fish species in the collection of the Hungarian Natural History Museum that were gathered in the Gemenc region between 1957 and 1960 (Berinkey, 1972). Observations of amateur ichthyologists resulted in a list of 47 fish species in the area from 1970 to 1995 (Kalocsa and Schmidt, 1996), while the surveys of the Hungarian Danube Research Station have recorded 44 species since 1994. According to the historical and recent data, occurrence of 56 fish species were recorded in this Danube section. Most of the original fauna is still present, only large migratory sturgeons (*Huso huso, Acipenser gueldenstaedti, A. stellatus, A. nudiventris*) have disappeared due to overfishing and the blocking of their migratory route. The presence of *Umbra krameri* was not confirmed during the recent investigations. However, a specimen collected in 1957 (Berinkey, 1972) documents its previous occurrence (Table 1).

Fish species distribution is not accidental within a river system. The composition, density and biomass of fish assemblages depend on the nature of the functional sets or their particular biotopes. The fish fauna, or the structure of fish assemblages represents an important aspect in the evaluation of ecological functions of different water bodies in floodplain rivers (Holčik et al., 1981; Schiemer and Spindler, 1989; Schiemer et al., 1991; Schiemer and Waidbacher, 1992; Peňáz et al., 1991; Guti, 1993).

For instance, the fauna composition of the eupotamic main riverbed is dominated by rheophilic fish species (*Acipenser ruthenus, Barbus barbus, Chondrostoma nasus, Gymnocephalus cernuus, Zingel zingel, Cottus gobio,* etc.) that bound to the lotic component of the river. The connected backwaters represent the parapotamic functional set and their fauna includes several rheophilic and eurytopic fish species. Species grouped in the eurytopic guild (*Rutilus rutilus, Alburnus alburnus, Blicca bjoerkna, Perca fluviatilis, Proterorhinus marmoratus,* etc.) occur in all types of lotic and lentic components of the river. The disconnected plesiopotamic or paleopotamic backwaters are populated with eurytopic and limnophilic fish species (*Scardinius erythrophthalmus, Carassius carassius, Tinca tinca, Misgurnus fossilis, Umbra krameri,* etc.) that bound to the standing waters of the floodplain. In general, the diversity of fish species is the greatest in the eupotamon and parapotamon and it tends to decrease in the plesio- and paleopotamon, while the fish biomass shows an opposite trend (Holčik et al., 1989).

Table 1. List of fish species found in the different type of water bodies (1 = main riverbed, 2 = connected backwaters, 3 = disconnected standing waters) in the Gemenc region of the Danube. ■ common, ▪ rare, x historical data

Fish species	1	2	3
Eudontomyzon mariae			
Acipenser ruthenus	▪		
Acipenser gueldenstaedti	x		
Acipenser nudiventris	x		
Acipenser stellatus	x		
Huso huso	x		
Oncorhynchus mykiss			
Umbra krameri			x
Esox lucius	▪	▪	▪
Rutilus rutilus	■	■	■
Rutilus pigus virgo			
Ctenopharyngodon idella			
Scardinius erythrophthalmus		■	■
Leuciscus leuciscus	■	■	■
Leuciscus cephalus	■	■	■
Leuciscus idus	■	■	■
Aspius aspius	■	■	■
Alburnus alburnus	■	■	■
Blicca bjoerkna	■	■	■
Abramis brama	■	■	■
Abramis ballerus	■	■	
Abramis sapa	■		
Vimba vimba	■		
Pelecus cultratus	▪		
Tinca tinca			▪
Chondrostoma nasus	■		
Barbus barbus	■		
Gobio gobio	■		
Gobio albipinnatus	■		
Pseudorasbora parva		■	■
Rhodeus sericeus amarus			■
Carassius carassius			■
Carassius auratus	■	■	■
Cyprinus carpio	■	■	■
Hypophthalmichthys molitrix	■		
Aristichthys nobilis			
Misgurnus fossilis			■
Cobitis taenia			
Silurus glanis	▪		
Ameiurus nebulosus			
Ameiurus melas		▪	
Anguilla anguilla	■		
Lota lota	■		
Lepomis gibbosus	■	■	■
Micropterus salmoides			
Perca fluviatilis	■	■	▪
Gymnocephalus cernuus	■		
Gymnocephalus baloni	■		
Gymnocephalus schraetzer	■		
Stizostedion lucioperca	■	▪	
Stizostedion volgense			
Zingel zingel	■		
Proterorhinus marmoratus	■	▪	▪
Neogobius fluviatilis	■		
Neogobius kessleri	■		
Neogobius syrman			

Using fish in the typological analysis of the fluvial hydrosystem has several advantages:

- fish sampling and identification is relatively fast and easy,
- the environmental requirements of fish are more widely known than those of invertebrates or other taxonomic groups,
- fish are on the top of the aquatic food chain and therefore integrate the response of the food chain to environmental change,
- fish are relatively long-living organisms therefore their population structure indicates the fluctuation of environmental variables over a long period.

Acknowledgements. The present study was supported by the János Bolyai Research Fellowship and the Danubius Project of the Hungarian Academy of Sciences.

REFERENCES

1. AMOROS, C. (1991): Changes in sidearm connectivity and implications for river system management. - Rivers, 2: 105–112.
2. AMOROS, C., ROUX, A. L., REYGROBELLET, J. L., BRAVARD, J. P. & PAUTOU, G. (1987): A method for applied ecological studies of fluvial hydrosystems. - Regulated Rivers, 1: 17–36.
3. ANDRÁSFALVY, B. (1973): A Sárköz és a környező Duna-menti területek ősi ártéri gazdálkodása és vízhasználatai a szabályozás előtt. - Vízügyi Történeti Füzetek, 6: 1–75.
4. BALON, E. K. (1967): Vyvoj ichthyofauny Dunaja, jej sucasny stav a pokus o prognozu dalsích zmien po vystavbe vodnych diel. - Biologicke prace, 13: 1–121.
5. BERINKEY, L. (1972): Magyarország és a r. Hung., 13: 3–24.
6. BULLA, B. (1962): Magyarország természetföldrajza. - Tankönyvkiadó, Budapest: 1–424.
7. GUTI, G. (1993): Fisheries ecology of the Danube in the Szigetköz floodplain. - Opusc. Zool., Budapest, 26: 67–75.
8. GUTI, G. & KERESZTESSY, K. (1997): Effects of long-term hydrological changes on fish communities in the Middle-Danube. - 32. Konferenz der IAD, Wien, 2: 161–176.
9. HOLČIK, J., BASTL, I., ERTL, M. & VRANOVSKY, M. (1981): Hydrobiology and ichthyology of the Czechoslovak Danube in relation to predicted changes after the construction of the Gabcikovo-Nagymaros River Barrage System. - Práce Lab. Ryb r. Hydrobiol., 3: 19–158.
10. HOLČIK, J., BĂNĂRESCU, P. & EVANS, D. (1989): General introduction to fishes. - In: J. Holčik (ed.) The freshwater fishes of Europe. 1/II. - AULA-Verlag, Wiesbaden: 18–147.
11. IUCN (1995): River corridors in Hungary: A strategy for the conservation of the Danube and its tributaries (1993-1994). - IUCN, Gland Switzerland and Budapest, Hungary: 1–124.
12. KALOCSA, B. & SCHMIDT, A. (1996): Halfajok a Dunában és mellékágaiban Baja környékén. - Bajai Honpolgár, 1996/3: 7.

13. KÁROLYI, Z. (1973): A Duna-völgy vizeinek szabályozása. - In: Ihrig D. (ed.): A magyar vízszabályozás története. - Országos Vízügyi Hivatal, Budapest: 155–248.

14. PÉCSI, M. (1959): A magyarországi Duna-völgy kialakulása és felszínalaktana. - Akadémiai Kiadó, Budapest: 1–346.

15. PEŇÁZ, M., COPPG. H., OLIVIER, J. M. & ROUX, A. L. (1991): Fish reproductive potential of regulated fluvial ecosystems: An application of juvenile fishes as functional describers. - In: M. Peňáz (ed.): Biological monitoring of large rivers, Brno: 93–98.

16. RAKONCZAY, Z. (1987): Kiskunságtól a Sárrétig. A Dél-Alföld természeti értékei. - Mezőgazdasági Kiadó, Budapest, 1–320.

17. ROUX, A.L., *et al.* (1982): Cartographie polythématique appliquée a la gestion écologique des eaux. - CNRS, Lyon: 1–113.

18. SCHIEMER, F. & SPINDLER. T. (1989): Endangered fish species of the Danube River in Austria. - Regulated Rivers, 4: 397–407.

19. SCHIEMER, F., SPINDLER, T., WINTERSBERGER, H., SCHNEIDER, A. & CHOVANEC, A. (1991): Fish fry associations: Important indicators for the ecological status of large rivers. - Verh. Internat. Verein. Limnol. 24: 2497–2500.

20. SCHIEMER, F. & H. WAIDBACHER (1992): Strategies for conservation of a Danubian fish fauna. - In: P. J. Boon, P. Calow, G. Petts (eds.): River conservation and management. - John Wiley & Sons Ltd.: 363–382.

21. UDVARDY, M. (1959): Notes on the ecological concepts of the habitat, biotope and niche. - Ecology, 40: 725-728.

22. WELCOMME, R. L. (1979): Fisheries ecology of floodplain rivers. - Longman Group Ltd., London, 1–297.

23. WELCOMME, R. L. (1983): River basins. - FAO Fisheries Technical Paper, 202: 1–60.

24. WELCOMME, R. L. (1985): River fisheries. - FAO Fisheries Technical Paper, 262: 1–330.

Feeding parameters of young mallards *(Anas platyrhynchos)* and their effects on water quality of Lake Kis-Balaton, Hungary

By

J. JUHÁSZ and G. GERE*

Abstract. Concerning their large density and fast metabolism, the aquatic birds take part an important role in the material cycle. It is important therefore to know the feeding parameters of different age classes of mallard. According to our result, over the studying of feeding characteristic of omnivorous mallards, we consider that the chemical compositions of their feces reflected the characters of the differences between the different feeding groups. The N-content of piscivorus cormorant feces was almost 8 times higher than the same volume of herbivorous geese. The N-content of omnivorous mallards occurred between them. That is why, it is reasonable to study the effects on water quality of the different feeding groups of aquatic birds.

By means of the large density and fast metabolism of aquatic birds, they play an important role in the aquatic material cycle. But their production-biological role was not known entirely. There were especially few data concerning the young birds. It was true but nowadays the number of experiments seemed to become higher (e.g. Juhász, Andrikovics & Gere, in press). Many experiments and calculations were made with cormorants that take away considerable organic matter from the water (Gere & Andrikovics, 1986). Recently, the old and the new data on the feeding habits of the cormorants were summarized (van Dobben, 1995).

In Hungary, the herbivorous Grey-lag goose and another geese were investigated in the field (Sterbetz, 1992) and in captivity (Andrikovics, Gere & Futó, 1997; Andrikovics, Gere & Lelkes, 1998; Juhász, Gere & Andrikovics, 1999). Omnivorous ducks were also investigated (Gere & Andrikovics, 1994).

Food of common aquatic birds analyzed their gut content around the Lake Balaton was studied (Ponyi, 1992). Effects of these birds for the trophic level proved rather complicated. These problems conducted us to repeat our earlier examinations. We simulated more accurately the wild conditions and used ten young mallards in our lab-experiments.

*Judith Juhász and Dr. Géza Gere, ELTE Állatrendszertani és Ökológiai Tanszék (Department of Systematic Zoology and Ecology of the Eötvös Loránd University), 1088 Budapest, Puskin u. 3, Hungary.

Table 1. Production-biological parameters of young mallards (Group I, average of 3 birds)

Date in 1998	Type of food	Consumed food (g)	Growth (g) Living mass	Growth (g) Dry mass	Feces (g)	P/C 100	FU/C 100
06/06	Special mixed food	117,90	38,66	10,05	32,22	8,58	27,32
07/06	Special mixed food	89,44	25,33	6,58	16,34	7,35	18,26
10/06	Corn	63,00	-12,66	-3,29	6,40	-5,22	10,15
11/06	Corn	69,03	2,61	0,67	28,06	0,97	40,64
15/06	*Mixed food	38,58	12,00	3,12	10,72	8,08	27,78
16/06	*Mixed food	41,72	13,20	3,43	17,58	8,22	42,78
22/06	Special mixed food	36,66	14,00	3,64	9,11	9,92	24,84
23/06	Special mixed food	43,86	14,92	3,87	10,65	8,82	24,28
31/07	*Mixed food	46,98	14,00	3,64	10,42	7,74	22,17
01/08	*Mixed food	54,21	17,30	4,49	20,05	8,28	36,98

P = production, increasing of body mass in dry weight. (The water content of mallard was considered 74%; Austin, 1976), FU = feces + urin, C = consumption (in air dried material), * = composition of food: corn, grass, insect larvae and snail.

Materials and methods

Field observations

Ornithological observations were carried out in the territory of Lake Kis-Balaton. The population size of the mallard was counted. We observed the regular resting and feeding places of the birds and registrated the time interval when they stay in the water and in the land. This work was conducted by Lelkes and

Feeding experiments

30-35 days young mallards were used in our experiments. Before the beginning of the experiments, we made accustomed the birds to captivity. Twocaptivity. Two mallards were put in a cage measured 2.25 m^2. The bottom of cages were done from plastic screen. Under the cages, changeable, collectingtrays were put down. The birds were fed by measured food every day and the est of the food also measured after 24 hours. So the consumption, the feces and changes of birds body mass were registrated. In one part of the

Table 2. Production-biological parameters of young mallards (Group II)

Date	Type of food	Consumed food (g)	Growth (g) Living mass	Growth (g) Dry mass	Feces (g)	P/C 100	FU/C 100
06/06	Special mixed food	70,52	25,30	6,57	13,85	9,31	19,63
07/06	Special mixed food	22,52	10,66	2,77	6,07	12,30	23,65
10/06	Corn	49,60	-4,00	-1,04	9,81	-0,02	10,77
11/06	Corn	57,80	13,70	3,56	30,01	6,15	51,92
15/06	*Mixed food	44,59	20,00	5,20	13,27	11,66	29,76
16/06	*Mixed food	59,16	21,30	5,53	18,09	9,34	30,57
22/06	Special mixed food	110,61	26,00	6,76	27,01	6,11	20,99
23/06	Special mixed food	91,08	19,00	4,49	23,00	5,42	25,25
31/07	*Mixed food	58,91	10,66	2,77	22,03	4,70	37,39
01/08	*Mixedfood	67,38	14,70	3,82	30,11	5,66	44,68

experiment, special, artificial, plant and animal like material composed by the Purina firm was partly fed by the ducks. This special mixed food – according to the observations – especially satisfied the ducks requirements. The artificial food contained 16.5% protein, 3% fatty material and 5.5% plant material. In other case, the ducks were fed with grits corn. In also another cases, mixed food of corn, grass, insect larvae and snail were used to feed the mallards. Measurements usually took place in air dry conditions. Grass was measured in the form of fresh weight, but also control samples were used to establish the water content of the grass.

Analytical methods

The N-content of the samples was determined by the Kjeldahl-method. The P-content was measured by the photometry-method. The usual method was modified. During the wet burning, we used mixed nitric acid and hydrogen peroxide, because the carbonization was lower degree. In the case of atmospheric approach used by sulfuric acid, large quantity of activated carbon came into which adsorbed a lot of measurable material, so the mistake of measurement would be high.

Table 3. Data from the nitrogen and phosphate content of the excrement of mallards

Data in 1998	Type of food	Total nitrogen %	Excrements PO_4^{3} mg/kg	Total phosphorus mg/kg
06/06	Special mixedfood	3.43	2.52	0.82
07/06	Special mixedfood	3.40	2.92	0.95
10/06	Corn	3.37	2.70	0.88
15/06	*Mixed food	2.44	3.16	1.03
22/06	Special mixedfood	3.84	2.60	0.84
31/07	*Mixed food	4.21	1.80	0.58

Results and evaluations

Results of field examinations

The role of mallard in eutrophication is very complicated. In 1997 the result of the census of mallard population was as follows: nesting population 500-560 pairs; wintering, migrating population from October 1997 to April 1998 changed between 2500-10,300 individuals.

The young mallards feed from the water but they rest and defecate on the shore, so they take organic materials from the water but they reduce the trophic level of the water. The adult birds mainly feed from the land and called on the water, they put main part of their feces into the water, they increase the eutrophication (Gere & Andrikovics, 1994).

Results of feeding experiments and lab-investigations

The data of food consumption and the produced feces were tabulated in the Tables 1 and 2. These Tables show that for the young ducks the special mixed food was the most optimal food; in this case the amount of waste matter was the lowest. The level of sorting out was between 18.26% and 27.32%.

Nitrogen content of extrements produced by piscivorous cormorants was between 13–15% The nitrogen content of extrement of mallard changed between between 2.44%–4.21%. This value in the case of the herbivorous Grey-lag goose was only 2.2% (Juhász, Gere & Andrikovics, 1998). The significant alternations of the nitrogen content in the extrements showed the differences in the feeding types of aquatic birds. It is worth for mentioning that in the extrement of young mallards the phosphorus content was significantly lower than it was found in the case of the cormorants or Grey-lag goose. The

phosphorus content of young duck extrement was only under the 0.01%. The phosphorus content of cormorants extrements changed between 4.5% and 5.5% (Gere & Andrikovics, 1992) and in the case of Grey-lag goose was 0.43% (Juhász, Gere & Andrikovics, 1998). The above mentioned facts showed for us that the aquatic birds with different feeding types took different role in the eutrophication processes. The population size of the mallard was very high in the Kis-Balaton territory, so their direct effects to the inner loading might be also significant.

Summary

The density of mallards in Kis-Balaton was very high in 1997. These were no exact data of droppings concerning the young birds. The nitrogen and phosphorus content of their droppings were analyzed and compared with the same data of cormorants and Grey-lag goose. The nitrogen content of young ducks was 2.44% to 4.21%. It was much more lower than it was found in the case of piscivorous cormorants and it was little higher than it was measured in the case of young geese.

The phosphorous content of the droppings was extremely low in the case of the young ducks. The all data were under the 0.01%. These data concerning the excrement of young aquatic birds showed that – not surprisingly – the role of the omnivorous ducks in the eutrophication is rather complex, but if the density of the birds is high, they very often increase the trophic level of aquatic ecosystems.

Acknowledgements: The authors thank András Lelkes for his help providing the population size data of mallards in Kis-Balaton.

REFERENCES

1. ANDRIKOVICS, S., GERE, G. & LELKES, A. (1996): A nyári lúd hatása a Kis-Balaton eutrofizációs folyamataira. – 2. Kis-Balaton Ankét Keszthely, 1996. szeptember 9-11.: 504-513.
2. ANDRIKOVICS, S. & GERE, G. (2000): Direct and indirect effects of aquatic birds on lotic and lentic habitats. – Sylvia, Journ. Ornithol., Praha: 36-47.
3. AUSTIN, G. T. (1976): Body composition and organ weight of the vertin (Auriparus flaviceps). – GT. Basin Nat., 31: 66-68.
4. GERE, G. & ANDRIKOVICS, S. (1986): Untersuchungen über die Ernährungsbiologie des Kormorans (Phalacrocorax carbo sinensis) sowie deren Wirkung auf den trophischen Zustand des Wassers des Kis-Balaton, I. – Opusc. Zool. Budapest, 2: 67-76.

5. GERE, G. & ANDRIKOVICS, S. (1990): Effects of some waterflows to the water quality. – Soc. Int. Limnologiae, „The Dynamics and Use of Lacustrine Ecosystems", Helsinki.

6. GERE, G., ANDRIKOVICS, S., CSÖRGŐ, T. & TÖRÖK, J. (1990): A kárókatonák (Phalacrocorax carbo) szerepe a Kis-Balaton vízminőségének alakításában. – A Magyar Madártani Egyesület II. Tudományos Ülése, Szeged, p. 88-94.

7. GERE, G. & ANDRIKOVICS, S. (1991a): Feeding of different waterfowls and their effects on the water quality. – „Aquatic Birds '91". Internat. Symp. Aquatic Birds, Sackwille, New Brunswick, Canada, p. 10.

8. GERE, G. & ANDRIKOVICS, S. (1991b): Untersuchungen über die Ernährungs-biologie des Kormorans (Phalacrocorax carbo sinensis) sowie deren Wirkung auf den trophischen Zustand des Wassers des Kisbalaton, II. – Opusc. Zool. Budapest, 24: 115-127.

9. GERE, G. & ANDRIKOVICS, S. (1992a): Effects of waterfowl on water quality. – Hydrobiologia, 243/244: 445-448.

10. GERE, G. & ANDRIKOVICS, S. (1992b): A kárókatonák (Phalacrocorax carbo) szerepe a Kis-Balaton szervesanyag forgalmában. – Aquila, 99: 27-32.

11. GERE, G. & ANDRIKOVICS, S. (1994): Feeding of ducks and their effects on water quality. – Hydrobiologia, 279/280:157-161.

12. JUHÁSZ, J., GERE, G. & ANDRIKOVICS, S. (1998): Felnőtt nyári ludak produkció-biológiai paramétereinek vizsgálata, és hatásuk a Kis-Balaton vízminőségének változására. – Acta. Acad. Ped. Agriensis, 22: 47-59.

13. PONYI, S. (1992): Abundance and feeding of wintering and migrating aquatic birds in two sampling areas of Lake Balaton in 1983–1985. – Hydrobiologia, 279/280: 63–69.

14. STERBETZ, I. (1994): A Balatonon telelő északi vadlúd tömegek exkrétum-produkciója. – Aquila, 99: 33–40.

15. VAN DOBBEN, C. M. (1995): The food of the cormorant, Phalacrocorax carbo sinensis: Old and new research compared. – Ardea, 83: 139–143.

Limnological investigations of small water bodies in the Pilis Biosphere Reserve, Hungary
Part II. Kőhegyi-tó and Unkás-tócsa

By

A. KISS*

Abstract. The regular limnological investigation of small, lentic, forest water bodies in the Pilis Biosphere Reserve began in 1998. The water chemistry and the Crustacea (Cladocera, Ostracoda, Copepoda) fauna of these waters are studied seasonally. Twenty-six and seven Crustacea species were recorded in the Kőhegyi-tó (Kőhegyi-Lake) and the Unkás-tócsa (Bombina Pond), respectively. The ostracode *Heterocypris reptans* recorded from the Unkás-tócsa is new to Hungary. The Kőhegyi-tó has the most diverse and abundant Cladocera communities among the investigated ponds. A few Cladocera species (e.g. *Ceriodaphnia dubia, Kurzia latissima, Diaphanosoma brachyurum, Alona quadrangularis*) have been detected only in this pond.

The Pilis Biosphere Reserve is situated northwest to Budapest in the Pilis and the Szentendre-Visegrádi Mountains, and has an extent of 23,000 hexctares. The two mountains are diverse in geological and geographical respect, the Pilis is mainly formed from Triassic limestone, the Szentendre-Visegrádi Mountains is volcanic, predominantly consisting of andesite.

The regular, systematic survey of streams and small water bodies in the Pilis Biosphere Reserve started in 1982 (Berczik, 1984). The basic limnological investigations of small water bodies began in 1998 (Kiss, 2000). Our study included the determination of the most important water chemistry and environmental parameters, as well as the species composition of the Crustacea (Cladocera, Ostracoda, Copepoda) fauna in twenty-one small waters. The general environmental description, the water chemistry field-work measurements, the presentation of the Crustacea fauna as well as the synthetic evaluation of former publications were carried out by the author, and the results of the water chemical laboratory analyses were derivedfrom M. Gánti-Papp. In this paper we present our data of the adjacent Kőhegyi-tó and Unkás-tócsa, considering that about former conditions of these two ponds several scientific data have been published.

**Anita Kiss,* MTA ÖBKI, Magyar Dunakutató Állomás (Hungarian Danube Research Station of Ecology and Botany of the Hungarian Academy of Sciences), 2163 Vácrátót, Alkotmány u. 2-4, Hungary.

General description of the study area

The Kőhegyi-tó and the neighbouring Unkás-tócsa are situated on the top of the Kő-hegy (Kő-Mountain) at 366 m above sea-level, north to Pomáz, in the southern part of Szentendre-Visegrád Mountains (Fig. 1). They are temporal forest water bodies. The Kőhegyi-tó can be found in a round depression and fed by precipitation. In spring it also gets water from a side arm of the Bükkös Stream. The lake is surrounded by a *Querco-petraeae-Carpinetum* forest and a wide *Phragmites* and *Carex* belt with occasional *Salix* and *Pinus* individuals. The water surface is nearly completely covered by aquatic macrophytes (mainly by *Lemna minor* L., *Spirodela polyrrhiza* (L.) Schleid, *Myriophyllum verticillatum* L. and *Polygonum amphibium* L.). Its surface area reached 120 × 70 m with a 90 cm water depth in spring, 2000. The Kőhegyi-tó very rarely dries out, it was wet even during the dry summer of 2000.

The Unkás-tócsa is a shallow temporal water body, which usually dries out completely in summer. It is located approximately 200 m away from Kőhegyi-tó in the meadow next to Kőhegy Tourist Lodge, and fed only by precipitation. Its largest surface area was 15 × 20 m in 1999–2000. Only one *Carex* sp. and small filamentous algae colonies were found in this ephemeral water, which was named after the Fire-bellied toad (*Bombina bombina*) visiting this pond in large number when it is wet.

Considerable human impact, mainly trampling affects both water bodies due to the neighbouring tourist lodge. Increased tourism might also have played a role in the complete disappearence of *Sphagnum* species and *Nuphar* from the Kőhegyi-tó, where it existed earlier (Nógrády, 1962).

Previous studies

Palik (1941) sampled the algae communities of Kőhegyi-tó several times in 1941, she detected 61 algae species. She also investigated the Tólaki-láp lying 1800 m away from this site a year earlier (Palik, 1940). Both water bodies are fed by precipitation, their pH and conductivity were low. Palik (1940) detected different *Sphagnum* species in the Tólaki-láp. A number of species indicating low pH and bog-like conditions, mainly from the genera *Cosmarium, Staurastrum* and *Closterium* of the Desmidiales order, were described from both waters. A high number (22) of species lived in both habitats while several peat-related algae species (e.g. *Closterium lineatum* Ehrenb., *C. jenneri* Ralfs, *Cosmarium speciosum* Lund., *Staurastrum striolatum* Arch. and *Characium braunii* Bruegger) existed only in the Tólaki-láp.

Nógrády (1962) studied the Rotifera, Gastrotricha, Cladocera and Copepoda fauna of Kőhegyi-tó in 1956 from June to October every month. He

classified Kőhegyi-tó as a peat bog, because he found *Sphagnum* patches in the reed and *Carex* weed belt around the lake. During his studies the water surface reached 100 × 100 m with a 120 cm water depth. A *Nuphar* stand covered the middle of the lake. He recorded fifty-one Rotatoria, five Gastrotricha, twenty Cladocera and six Copepoda taxa from the lake

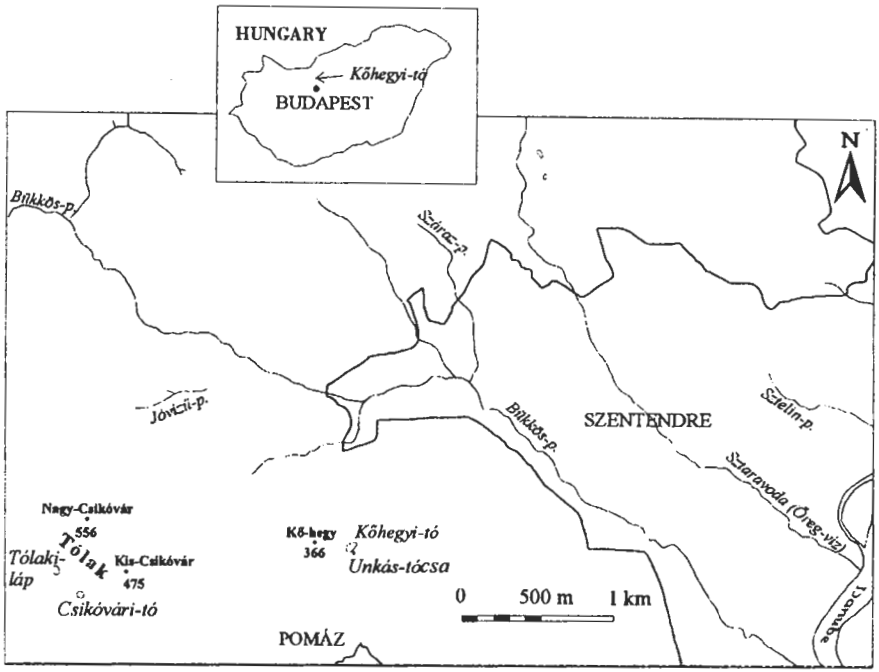


Fig. 1. The study area

including two new Rotatoria species, *Cephalodella conica* and *Lecane urna*. Among Cladocera, he also found *Alona protzi*, which had only been known from Lake Balaton, Hungary, and *Graptoleberis testudinaria* and *Daphnia magna* which are very rare in the small water bodies of the Pilis Mountains.

Methods

Water chemistry measurements were carried out in the middle of the open water areas of the ponds, zoological samples were collected from different microhabitats (open water, floating macrophytes, reeds, weed, logs, roots, rocks, etc.). Six seasonal sampling was carried out between 1999 and

Table 1. Water chemistry data of the Kőhegyi-tó and Unkás-tócsa. (1941 and 1956 data were published by Palik (1941) and Nógrády (1962); 1999-2000 data were derived from bthe author)

	Date	Kőhegyi-tó	Unkás-tócsa
Water surface (m)	23. 09.1956	100x100	
	15. 04.1999	110x70	20x15
	05. 08.1999	100x60	15x8
	31. 10.1999	95x55	dried out
	17. 04. 2000	120x70	15x10
	28. 08. 2000	15x10	dried out
	15. 10.2000	5x3	dried out
pH	06.1941	5.8-6.3	
	09.1941	5.5	
	23. 09. 1956	5.8	
	15. 04. 1999	6.86	7.41
	05. 08.1999	6.45	7.14
	31. 10. 1999	5.73	dried out
	17. 04. 2000	6.92	7.38
	28. 08. 2000	6.66	dried out
	15. 10.2000	9.09	dried out
Conductivity	15. 04. 1999	132	125
(μS/cm)	05. 08. 1999	118	210
	31. 10. 1999	82.5	dried out
	17. 04.2000	91.5	98
	28. 08. 2000	166	dried out
	15. 10. 2000	253	dried out
Dissolved oxygen	23. 09. 1956	7.1	
(mg/l) and	15. 04. 1999	9.63 (92%)	12.35 (137%)
saturation	05. 08. 1999	4.55 (54%)	8.93 (105%)
	31. 10. 1999	3.5 (31%)	dried out
	17. 04. 2000	10.35 (110%)	14.79 (177%)
	28. 08. 2000	14.84 (170%)	dried out
	15. 10. 2000	18.5 (214%)	dried out

2000 (15. 04. 1999, 05. 08. 1999, 31. 10. 1999, 17. 04. 2000, 28. 08. 2000 and 15. 10. 2000). Water chemistry parameters were measured with a portable WTW Multiline-P4 multifunctional field equipment. Temperature, pH, conductivity, dissolved oxygen concentration and oxygen saturation were recorded.

Table 2. Water chemical characterisation of the Kőhegyi-tó. (The new analyses were made by M. Gánti-Papp, Hungarian Danube Research Station of the Hungarian Academy of Sciences)

	Kőhegyi-tó 23. 09. 1956 (Nógrády, 1962)	Kőhegyi-tó, 17. 04. 2000
Suspended matter (mg/l)		5.0
Total dissolved solids (mg/l)		17
Turbidity (mg/l)		35
Alkalinity (W^0)	0.2	1.01
Total hardness (nk^0)	2	3.25
Ca hardness (nk^0)	2	1.81
Mg hardness (nk^0)		1.44
HCO_3^- concentration (mg/l)		60.39
CO_3^{2-} concentration (mg/l)		0.0
Ca^{2+} concentration (mg/l)	14	12.97
Mg^{2+} concentration (mg/l)	0.0	6.27
NO_3^- concentration (mg/l)		0.0
PO_4^{3-} concentration (mg/l)		0.03
SO_4^{2-} concentration (mg/l)	0.0	0.0
Total chemical oxygen demand (mg O_2/l)		29.61
COD of dissolved matter (mg O_2/l)		25.85
COD of particulated matter (mg O_2/l)		3.76

Qualitative samples were collected from all possible microhabitats with a 70 µm mesh size net to get a general overview of the Cladocera, Ostracoda and Copepoda fauna of the ponds. They were fixed in a 4% formaldehyde solution on the site.

Result and discussion

Water chemistry

The Kőhegyi-tó is a slightly acidic bog-like water body, rich in dark humic acids, with low conductivity, HCO_3^- and Ca^{2+} ion dominance (Tables 1 and 2). Its pH has moderately increased since Palik (1941) and Nógrády (1962) studied the lake, probably due to the pollution of the nearby tourist lodge. From summer 2000, the pH considerable increased due to water less through evaporation, a large number of filamentous algae and a large amount of wild

boar droppings. The intensive proliferation of filamentous algae resulted in a high concentration of dissolved oxygen in 2000.

Cladocera, Ostracoda and Copepoda fauna

Altogether 29 Crustacea species (19 Cladocera, 5 Ostracoda, 5 Copepoda) were recorded from the two ponds between April, 1999 and October, 2000 (Table 3).

	Kőhegyi-tó	Unkás-tócsa	Species present in both water bodies
Cladocera	18	2	1
Ostracoda	3	3	1
Copepoda	5	2	2

Of the twenty-one investigated forest water bodies, the Kőhegyi-tó had the highest Crustacea, and within them, Cladocera species number in the Pilis Biosphere Reserve. *Diaphanosoma brachyurum, Ceriodaphnia dubia, Kurzia latissima* and *Alona quadrangularis* were only recorded from there. Probable causes for the species richness are the stability of the aquatic habitats and the presence of diverse microhabitats, due to different macrophyton stands. *Moina brachiata*, which had been detected by Nógrády (1962), could not be found again in the Kőhegyi-tó in 1999-2000 though it was common in the Unkás-tócsa, which is only 200 m away. In that water body only seven Crustacea species were sampled in low abundance.

However, a small parthenogenetic population of *Heterocypris reptans*, a new Ostracoda species for Hungary, was first recorded from this temporal pond in April, 2000. It is known from several Central and Southern European countries (Slovakia, Slovenia, Croatia, Macedonia, Bosnia, France, Italy) with a northern distribution in Poland and a small population in Algeria (Meisch, 2000). Sexually reproducing populations have only been found in Croatia and Israel (Martens, 1996) so far. This phenomenon was described in several Ostracoda species. It is probably the effect of Ice Ages, when a lot of Ostracoda species disappeared from North Europe and moved to the Mediterranean. After the ice had retreated, only parthenogenetic populations could recolonise the northern areas while sexually reproducing ostracode populations survived in isolated Mediterranean refuges as relict populations.

Two common and abundant forest pond Ostracoda species (*Cyclocypris ovum* and *Cypria ophtalmica*) were missing from these ponds, probably due

*Table 3. The Cladocera, Ostracoda and Copepoda species in the Kőhegyi-tó and Unkás-tócsa. (++= abundant, += relatively abundant, (+)= low individual number, *= species also recorded by Nógrády, 1962)*

Species	Kőhegyi-tó	Unkás-tócsa
CLADOCERA		
Diaphanosoma brachyurum (Liévin)	(+) *	
Daphnia obtusa Kurz	+	
Daphnia longispina O. F. Müller	(+) *	
Simocephalus exspinosus (Koch)	++ *	
Simocephalus vetulus (O. F: Müller)	+	
Moina brachiata (Jurine)	*	++
Ceriodaphnia reticulata (Jurine)	+ *	++
Ceriodaphnia dubia Richard	(+)	
Ceriodaphnia laticaudata P. E. Müller	(+)	
Scapholeberis mucronata (O. F. M.)	(+) *	
Kurzia latissima (Kurz)	++ *	
Tretocephala ambigua (Lilljeborg)	(+)	
Oxyurella tenuicaudis (Sars)	(+) *	
Alona intermedia Sars	(+) *	
Alona quadrangularis (O. F. M.)	(+) *	
Alona affinis (Leydig)	(+)	
Alonella excisa (Fischer)	++	
Alonella exigua (Lilljeborg)	(+)	
Chydorus sphaericus (O.F. Müller)	++ *	
OSTRACODA		
Notodromas monacha (O. F. Müller)	+	
Heterocypris reptans (Kaufmann)		(+)
Cypridopsis vidua (O.F. Müller)	(+)	
Cypridopsis elongata (Kaufmann)		(+)
Sarscypridopsis aculeata (Costa)	(+)	(+)
COPEPODA		
Canthocamptus staphylinus (Jurine)	(+)	
Eudiaptomus vulgaris (Schmeil)	(+) *	
Eucyclops serrulatus (Fischer)	+	(+)
Cyclops strenuus strenuus Fischer	+	+
Megacyclops viridis (Jurine)	++ *	

to their isolation (the nearest Tólaki-láp is 1800 m away) and geographical location (mountain peak surrounded with steep, forested slopes).

From spring to autumn, the individual number of Cladocera was the highest in the Kőhegyi-tó. In spring and autumn *Chydorus sphaericus*, in

summer 1999 *Kurzia latissima* and *Alonella excisa*, in summer 2000 *Scapholeberis mucronata, Daphnia obtusa* and *Ceridaphnia reticulata* were predominant. In August, 2000 an ostracod, *Notodromas monacha* with a 90% juvenile population became extremly abundant in the desiccating lake.

Three times out of six sampling, the Unkás-tócsa was completely dry. In August, 1999 *Moina brachiata* was abundant with only several *Cypridopsis elongata* individuals in the water. In spring both *Moina brachiata* and *Ceriodaphnia reticulata* were abundant. Copepoda species were recorded only in April 2000 in the pond.

Due to continuous presence of diverse and abundant macrophyte stands, macrophyte-associated Cladocera communities predominated in the Kőhegyi-tó in all seasons. In 1999-2000, ten Cladocera species were found from the list of Nógrády (1962), which contained twenty species. Six species (*Alona protzi, Daphnia magna, Graptoleberis testudinaria, Leydigia acanthocercoides, Disparalona rostrata, Pleuroxus trigonellus*) from the 1956 list could not be found in any of the investigated small water bodies of the Pilis Biosphere Reserve in 1999-2000. Species and individual number of Ostracoda and Copepoda was low during the study period. No abundant spring Copepoda communities with *Cyclops strenuus strenuus* and *Megacyclops viridis* dominance were characterictic for most small water bodies in the Pilis and Szentendre-Visegrád Mountains developed in the Kőhegyi-tó.

Acknowledgements. This survey was supported by the "Danubius Project" of the Hungarian Academy of Sciences.

REFERENCES

1. BERCZIK, Á. (1984): A Pilis Bioszféra Rezervátum kutatási programja. – Állatt. Közlem., 46: 13-16.

2. KISS, A. (2000): Limnological investigations of small water bodies in the Pilis Biosphere Reserve, Hungary. Two forest ponds: Tólaki-láp and Csikóvári-tó. – Opusc. Zool. Budapest, 32: 103-112.

3. MARTENS, K. (1996): Note: On the *Heterocypris reptans* (Kaufmann, 1900) (Ostracoda, Cyprididae), a new record of Israel. – Israel Journ. Zool., 42: 287-291.

4. MEISCH, C. (2000): Freshwater Ostracoda of Western and Central Europe. – Suesswasserfauna von Mitteleuropa 8/3., Spektrum Akademischer Verlag, Berlin.

5. NÓGRÁDY, T. (1962): On the Rotifera and limnology of an Hungarian bog pond. – Canadian Journ. Zool., 40: 677-684.

6. PALIK, P. (1940): A hazai tőzeglápok algái. II. A tólaki tőzeges láp Pomáz mellett. – Index Horti Bot. Univ. Budap.4: 17-42.

7. PALIK, P. (1941): Adatok Budapest környékének algaflórájához. Kőhegyi-tó. – Borbásia, 3: 1-22.

Herpetological methods:
I. On the use of the road transect method in surveying amphibians with examples from different zoogeographical regions of Hungary

By

M. PUKY*

Abstract. Road transect survey can be a useful method in monitoring amphibians especially when the herpetofauna is poorly known and the available resources and personnel are limited. Besides providing fast data collection over a large area, this method also helps to conserve amphibians along the surveyed route by highlighting the distribution of the most frequent amphibian crossing sections, where mitigation measures should be carried out to lower amphibian road casualties.

The rapid destruction of many ecosystem types and the disappearance or serious decline of many species in the last three decades of the 20th century stresses the importance of environmental investigations. Among other programmes, large-scale zoological research projects are needed to understand, conserve and improve the present diversity of species, the stability and functioning of ecosystems on Earth (Purvis & Hector, 2000). Standardisation together with the testing of new methods to develop better sampling protocols is a key element of the process.

Among animals, freshwater organisms seem to be most threatened (Abramovitz, 1996; IUCN, 1996). Amphibians are among those groups, which need extra attention due to their biphasic life cycle, increased sensitivity and moderate migrating capacity. Their increased vulnerability was recognised early (Wake, 1991; Griffiths & Beebee, 1992) and a standardised protocol was compiled by Heyer *et al.* in 1994, which also included night driving as a supplementary method.

In several countries in Europe and elsewhere, herpetological research projects should include additional tasks for comparison with those countries where amphibians are better studied (Gasc *et al.*, 1997). In some regions basic (e.g. species distribution) data are still missing. Hungary is one of the countries where it is still to be collected (Puky, 2000 a) at the beginning of the

*Dr. *Miklós Puky*, MTA ÖBKI Magyar Dunakutató Állomás (Hungarian Danube Research Station of the Institute of Ecology and Botany of the Hungarian Academy of Sciences), 2131 Göd, Jávorka Sándor u. 14, Hungary.

third millennium. Besides the compilation of reliable information from thepast, further investigations are needed to cover the whole country. Financial resources and personnel are limited for this task, which urges the use of time- effective, low cost methods, which are suitable for surveying large areas fast but do not require a high number of investigators.

The road transect method was tested over three years in four different regions in Hungary. The methodological results of this work are presented and discussed in this paper.

Fig. 1. Location of the investigated areas in Hungary. (Bükk National Park includes the Eastern-Cserhát and the Mátra Landscape Protection Areas, too)

Sites and methods

In 1998 a new herpetological project was launched in Hungary to determine the extent of road casualties on the existing road system and work out appropriate mitigation solutions (Simonyi et al., 1999). The road networks in and around four national parks were studied for at least eighteen months, up to autumn, 2000. The Danube - Ipoly National Park is situated north of Budapest on both sides of the Danube (Fig. 1) mostly including mountains and riverine ecosystems. The Bükk National Park and the Mátra Landscape Protection Area are the highest regions in the country with the highest peak of

1,015 m above sea level. Here the survey area also included the Eastern-Cserhát Landscape Protection Area, a forested mountain range. The northern and central part of the Körös - Maros National Park includes a strikingly different lowland area dominated by rivers and canals of low flowing velocity in the southeastern part of the Great Hungarian Plain. Approximately 250 km of road was investigated in each of these regions.

A fourth protected area; the Balaton Uplands National Park with a 407 km road network was surveyed in 1999–2000. Due to the work of several authors the herpetofauna of the Balaton Uplands National Park is relatively well studied providing an excellent area for comparative studies. To test the effectiveness of the road transect method further, in April, 2000 a 187 km road section from Zalacsány to Veszprém was surveyed in the central part of the region in a single night.

The speed of the investigation was selected to be appropriate for the actual task. It varied from 15–35 km/hr during night driving and reached 50 km/hr during the day. Peak migration sections (i.e. over 50 individuals/km) were covered on foot. Both live and dead amphibians were recorded. Besides the characteristics of the crossing populations and road casualties, the surrounding habitats were described and if necessary mitigation measures were also suggested.

Results and discussion

Figure 2 shows the species composition and number of amphibian populations crossing roads in three protected regions in Hungary. Road casualties reflect well the local amphibian fauna. In the middle mountains *Bufo bufo* and *Rana dalmatina* (at high elevation with *Rana temporaria*, lower with *Hyla arborea*), in the lowlands *Bufo viridis* and *Rana esculenta* „complex" predominate.

Road transects can also be useful if only very limited time and personnel is available in case the survey is carried out under optimal conditions. In April 2000 a high number of amphibians (more than 1,500 individuals) was recorded during a night survey between Zalacsány and Veszprém. The species number of amphibians was strikingly high; altogether nine taxa were recorded. As this single night survey indicated all species (except *Bombina variegata*, which had been known only from one site in the investigated area) in the region (Ilosvay, 1985; Marián, 1988), it proved the usefulness of the method for mapping purposes.

Road transect is an effective method if environmental conditions are optimal, when, as the above described investigation proved, even a single night survey can provide reliable data on the presence of species. On the basis of a 120 day survey over a seven year period, rainy or very humid (over 95%) conditions with no or little wind are necessary (Schád *et al.*, 1999) during the migration period to get the best results. Besides the breeding migration in spring, the summer migration of juveniles, or to a lesser extent autumn

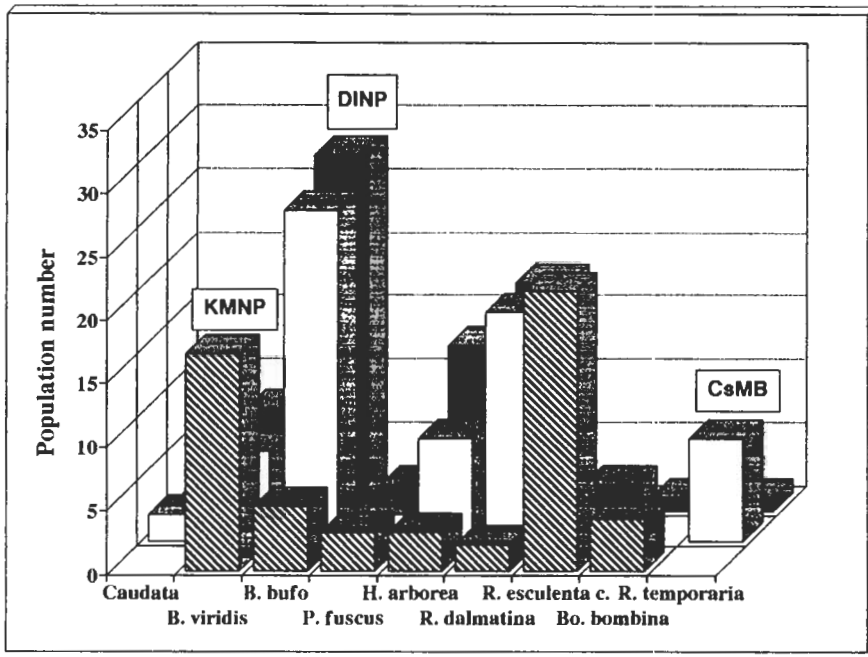


Fig. 2. Number of amphibian populations migrating over roads in three Hungarian national parks. (DINP = Danube - Ipoly National Park; CSMB = Eastern-Cserhát and Mátra Landscape Protection Areas, Bükk National Park; KMNP = Körös - Maros National Park)

migrations can also be effectively studied. The survey should be started after sunset and continued while amphibians are active, i.e. usually until midnight but on rainy nights it can last till nearly sunrise.

The road transect method has several limitations, which should be taken into consideration when the results are evaluated. Small animals (e.g. *Triturus vulgaris*) are often difficult to see especially when they are hit by the wheels and their presence can be underestimated. As a consequence, individual numbers recorded with this method are biased toward large animals and also toward species with longer migration routes. Amphibians with a short migration radius (e.g. *Rana arvalis*) are found on roads less frequently than their close relatives (e.g. *Rana dalmatina*) which cover longer distances. Local conditions are also crucial. If the road network is not developed, breeding sites are far from roads or most individuals hibernate near the breeding sites, certain species might not be detected or their relative individual number underestimated. In those cases other methods should also be used. Traffic intensity greatly affects the number of killed amphibians. However, as

amphibians tend to stay on the surface of roads longer due to its special microclimatic conditions or even for foraging, the presence of live specimens on roads can be an important indicator when gathering information on the local amphibian fauna (Puky, 2000 b).

Safety regulations are especially important to follow when the road transect method is carried out. For safety reasons it should not be applied if the traffic is too busy (at around 75 cars/hr and above) over the period of the investigation, when observations are also very difficult to make. Sudden stops should be avoided and the actual investigation of the animals should be done with extra care. At least two investigators should join for night transects but the ideal team is made of three people. Light reflecting clothes are advisable to wear by those who check amphibians out on the road to reduce the risk of accidents.

Road transect is an optimal method for making preliminary surveys for amphibians, covering relatively long distances in previously poorly studied areas. As at the moment basic herpetological information is missing from many areas in Hungary and in neighbouring countries, road transects can effectively be used in collecting such information in these regions. It is suggested that it be used extensively in the production of general, 10 km × 10 km UTM species distribution maps as the road network of the country is developed enough for this task.

As all amphibians are protected by law in Hungary, this method can also support other research projects e.g. by providing an opportunity to supply tissue samples for genetical studies without harming live individuals. Besides a fast data collection over a large area, this method also helps to conserve amphibians along the surveyed route by highlighting the distribution of the most frequent amphibian crossing sections, where mitigation measures should be carried out to lower amphibian road casualties.

Summary

1. Basic herpetological data (e.g. on species distribution at a national level) are still missing in Hungary.

2. Besides the compilation of reliable information from the past, further investigations are needed to complete this data collection.

3. Due to limited financial resources and personnel, the use of time-effective, low cost methods is highly recommended.

4. The road transect method was applied along a 1,160 km road network in and around four national parks.

5. Road transect limitations include a biased result toward large amphibians with long migration routes, which should be taken into consideration when the results are evaluated.

6. Safety regulations are important to follow to avoid accidents during fieldwork.

7. Road transect proved to be an effective survey method and it is suggested to use it extensively in the production of general, 10 km × 10 km UTM species distribution maps.

8. The application of this methodology can also support other amphibian projects by the collection of specimens and the conservation of the group by highlighting the distribution of the most frequent amphibian crossing sections.

Acknowledgement. The surveys described above were financially supported by the Hungarian Technical and Information Services on National Roads. I thank György Bertalan, Balázs Forgách, Dorottya Gémesi, Bence Hidvégi, Szabolcs Jónás, Péter Molnár, Ágota Neuwirth-Vass, Sándor Palkó, Zsuzsanna Puky, Zoltán Sallai, Ágnes Simonyi, Antal Széll, Ferenc Tompa, Tamás Tóth, Andrea Vogel and Zsolt Vogel for their practical help and support, and Dr. Julian Reynolds for comments on the English text.

REFERENCES

1. ABRAMOVITZ, J. (1996): Maintenance of freshwater ecosystems. - The State of the World, 60-78.

2. GASC, J. P. (ed.) (1997): Atlas of amphibians and reptiles in Europe. - Societas Europea Herpetologica & Mus. Nat. Hist. Nat., Paris, pp. 496.

3. GRIFFITHS, R. A. & BEEBEE, T. (1992): Decline and fall of the amphibians. - New Scientist, 1826: 25-29.

4. HEYER, W. R., DONELLY, M. A., MCDIARMID, R. W., HAYEK, L. C. & FOSTER, M. S. (eds.) (1994): Measuring and monitoring biological diversity: Standard methods for amphibians. - Washington: Smithsonian Inst. Press, pp. 364.

5. IUCN (1996): 1996 IUCN Red list of threatened animals. - IUCN, Gland. Switzerland, pp. 368.

6. ILOSVAY, GY. (1985): Az Északi-Balaton-part és a Balaton-Felvidék herpetofaunájáról. (On the herpetofauna of the northern shore of Lake Balaton and the Balaton Uplands.) - Fol. Mus. Hist.-nat. Bakonyiensis, 4: 191-212.

7. MARIÁN, M. (1988) A Bakony-hegység kétéltű és hüllő faunája (Amphibia, Reptilia). Herpetológiai alapvetés. (The amphibian and reptile fauna of the Bakony Mountains. A herpetological survey.) - Bakony Természettud. Kutat. Eredm., 20: 1-105.

8. PUKY, M. (2000 a): A kétéltűek védelme Magyarországon. (Amphibian protection in Hungary.) - In: FARAGÓ, S. (ed.): Gerinces állatfajok védelme. (Conservation of vertebrate species in Hungary.) Western-Pannonian Univ., Fac. Sylviculture: 143-158.

9. PUKY, M. (2000 b): A comprehensive three-year herpetological survey in the Gemenc Region of the Danube - Dráva National Park, Hungary. - Opusc. Zool. Budapest, 32: 113-128.

10. PUKY, M. & VOGEL, ZS. (1999): Kétéltűek vándorlási útvonalának feltérképezése. (Mapping amphibian migration.) - In: PETŐCZ, M. (ed.): Közutak Európában. IV.

Természetvédelem. (Public roads in Europe. IV. Nature conservation.), Techn. Inform. Serv. Nat. Roads: 31-37.

11. PURVIS, A. & HECTOR, A. (2000): Getting the measure of biodiversity. – Nature, 405: 212-219.

12. SCHÁD, P., PUKY, M. & KISS, I. (1999): A Naplás-tó Természetvédelmi Területen élő kétéltűek vonulási sajátosságai. (Migration characteristics of amphibians at the Lake Naplás Nature Conservation Area.) – Természetvéd. Közlem., 8: 161-172.

13. SIMONYI, Á., PUKY, M., TÓTH, T., PÁSZTOR, L., BAKÓ, B. & MOLNÁR, ZS. (1999): Progress in protecting wildlife from transportation impacts in Hungary and other European countries. – Third Internat. Conf. Wildlife Ecol. Transport., 1999. Sept. 13-16; Missoula, Montana: 279-287.

14. WAKE, D. B. (1991): Declining amphibian populations. – Science, 253: 860.

Seasonal activity of caddisflies (Insecta: Trichoptera) in the Börzsöny Mountains, North Hungary

By

D. SCHMERA*

Abstract. Trichoptera were collected by light trapping in the Börzsöny Mountains in 1996, 1998 and 1999 at Bernecebaráti and Királyrét. Caddisflies were listed into the following flight period types: short, medium or long flight activity, and autumn or summer species. The weekly flight activity patterns of some caddisfly species and their comparison are discussed.

In the temperate zone, the activity of adult Trichoptera is strongly regulated by seasonal conditions, thus, the coldest part of the year is typically unsuitable for flight and reproduction. As a result, the adult caddisflies show specific flight activity patterns. These patterns are different by regions of Europe. The information about the seasonal activity pattern of Trichoptera in Hungary is very limited.

The literature data on the flight of caddisflies in Hungary were divided into two parts. The qualitative data of the flight of a species can be characterized by a time interval (from May to June or from July to October, etc.) or by a definition (summer species or autumn species, etc.). On the other hand, the qualitative data show a frequency distribution among the studied time-intervals. Based on this division, there are many informations on the activity periods (qualitative data) of different species. Unfortunately, the interpretations of some definitions (summer species, autumn species, etc.) are not given in the Hungarian literature.

However, the flight periods (qualitative data) are not sufficient for information on the quantitative aspect of flight activity patterns. There are some data about the flight activity patterns of some caddisfly species from the Mecsek Mountains (Nógrádi, 1987; Nógrádi & Uherkovich, 1991) and from the Visegrádi Mountains (Nógrádi *et al.*, 1991). The quantitative data about the flight of caddisflies from the Northern Mountains are very limited. In this study, I intend to give more information about the activity periods and the flight activity pattern of some Hungarian Trichoptera species.

**Dénes Schmera,* MTA Növényvédelmi Kutatóintézet (Plant Protection Institute of the Hungarian Academy of Sciences), 1029 Budapest, Nagykovácsi út 26–30, Hungary.

Material and methods

Sampling sites

The study area can be found in the Börzsöny Mountains in North Hungary. The first study area at Bernecebaráti, at 300 m above sea-level, is found in the northern part of the Börzsöny Mountains, on andesite and andesite-tuff base. The second sampling site is located at Királyrét, at 350 m above see level, also in the Börzsöny Mountains.

Sampling methods

Caddisflies were caught by light traps. One light trap with a 160 W mercury vapour bulb, 2 m above ground level, was placed near the Bernecei Stream (Bernecebaráti, UTM CU42). This trap was operated from June to the end of October in 1996, and from May to the end of October in 1998.

The second light trap was operated with a 100 W normal bulb, 2 m above ground level at Királyrét (UTM CU40). The trap operated from May to the end of October in 1999. The light trap was placed near the Morgó Stream.

Flight activities

The percentages of the same species were studied at standard weeks (the first day of the year is the first day of the first standard week). The flight activity pattern of the species is given from the 19th to the 44th weeks (Fig. 1). The swarming of the species were calculated with the following formula: Swarming begins on a given standard week, when the number of specimens reaches 2.5% of the total catch. The swarming ends on the week, when the number of the specimens collected is 97.5% of the total catch. This calculation shows time interval of the flight of caddisflies (95% of the total catch). This number may be more informative about the flight, because the trimming of the earliest and latest catches works as noise elimination.

The length of the flight at studied caddisfly species is determined as follows. The lengths of the flight activities were listed into 3 artificial groups: long if the length of the flight activity is longer than 14 weeks. Medium long is the activity if the length of the flight activity is between 8 and 14 weeks, and short if the interval is smaller than 8 weeks.

The spring, summer or autumn species are defined on the occurrence of the highest percentage of the individuals collected in those periods.

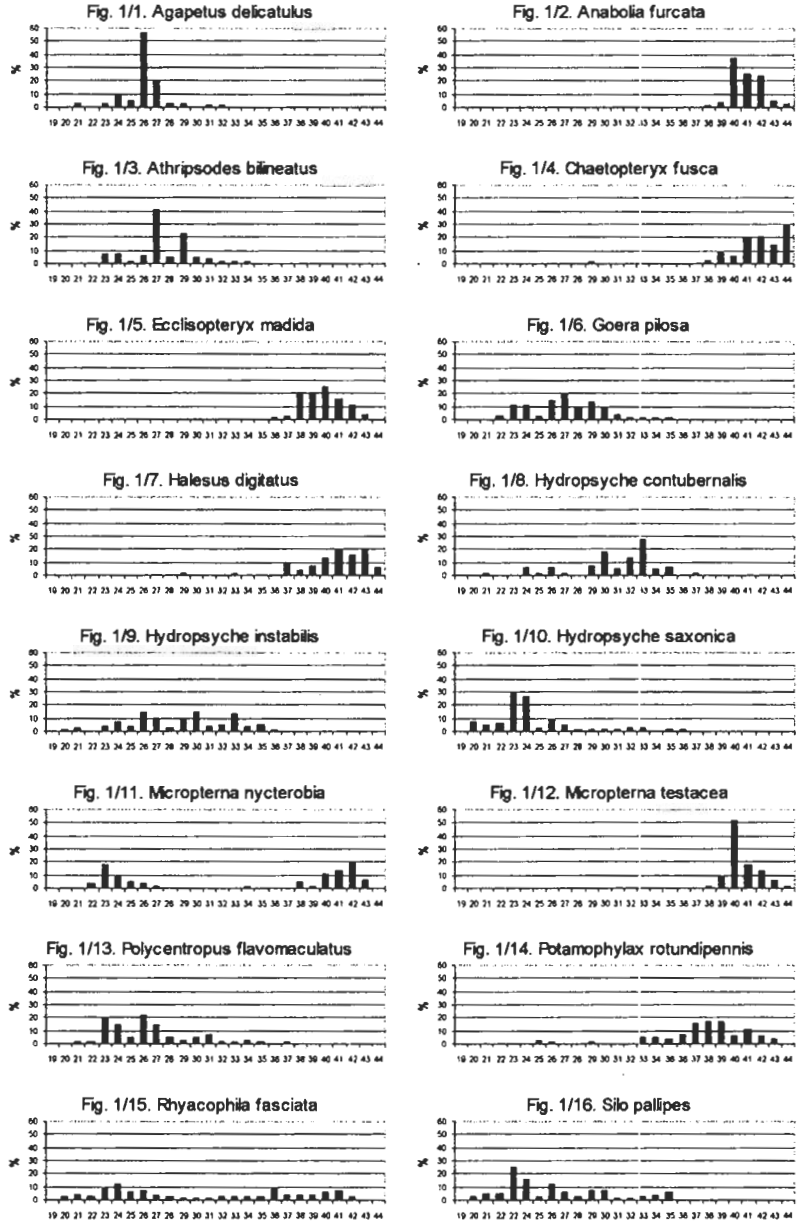


Fig. 1. The weekly flight activity pattern of some caddisfly species in the Börzsöny Mountains

Table 1. Number of individuals, and characteristics of swarming of sixteen caddisfly species observed in the Börzsöny Mountains

Species	Number of individuals	Swarming (in standard weeks)			
		Start	Medium	Stop	Length
Agapetus delicatulus McLachlan, 1884	288	23	26	30	7
Anabolia furcata Brauer, 1857	236	39	41	44	5
Athripsodes bilineatus Linnaeus, 1758	317	23	27	33	10
Chaetopteryx fusca Brauer, 1857	126	38	42	44	6
Ecclisopteryx madida McLaclan, 1867	194	37	40	43	6
Goera pilosa Fabricius, 1775	431	22	27	34	12
Halesus digitatus Schrank, 1781	182	31	41	44	13
Hydropsyche contubernalis McLachlan,1865	356	24	32	35	11
Hydropsyche instabilis Curtis, 1834	516	21	29	35	14
Hydropsyche saxonica McLachlan, 1884	960	20	24	32	12
Micropterna nycterobia McLachlan, 1875	229	22	*	43	*
Micropterna testacea Gmelin, 1798	438	39	40	43	4
Polycentropus flavomaculatus Pictet, 1834	165	23	26	34	9
Potamophylax rotundipennis Brauer, 1857	357	25	37	43	18
Rhyacophila fasciata Hagen, 1859	734	21	28	42	21
Silo pallipes Fabricius, 1781	332	21	24	35	14

*Not calculated

Results and discussion

Data of 5861 individuals belonging to 16 species were studied. The list of species is given in Table 1. The flight activity patterns of species are shown in Fig. 1. This study gives the first quantitative information about the flight activity patterns of *Agapetus delicatulus, Anabolia furcata, Chaetopteryx fusca, Ecclisopteryx madida, Goera pilosa, Hydropsyche instabilis, Micropterna testacea, Polycentropus flavomaculatus* and *Silo pallipes* in Hungary.

Agapetus delicatulus (Fig. 1/1). The only data about the flight activity pattern in Hungary come from Nógrádi *et al.* (1996). They give the following flight period: from June to July. My results are identical with their data. It is a summer species with short flight period.

Anabolia furcata (Fig. 1/2). Kiss (1978, 1984), Nógrádi *et al.* (1996) and Kiss et al. (1999) give some informations on the flight period of the species. It is an autumn species with a short flight period.

Athripsodes bilineatus (Fig. 1/3). There are no data about the flight of this species in the literature. This is a summer species with a flight period of medium length.

Chaetopteryx fusca (Fig. 1/4). There are several informations about the flight of this species (Kiss, 1979, 1987, 1989; Nógrádi *et al.*, 1996; Kiss *et al.*, 1999). It is a typical autumn species with a short flight period.

Ecclisopteryx madida (Fig. 1/5). We have good records on the flight period of this species (Kiss, 1979, 1983, 1984, 1987; Nógrádi *et al.*, 1996). It is an autumn caddisfly with a short flight period.

Goera pilosa (Fig. 1/6). There are some data about the flight period (Kiss, 1978; Nógrádi, 1985; Nógrádi *et al.*, 1996). It is a summer species with a flight period of medium length.

Halesus digitatus (Fig. 1/7). An autumn species (Kiss, 1978, 1983, 1984, 1987; Kiss *et al.*, 1999; Nógrádi et al., 1996) with a short flight period. There are also quantitative data about it (Kiss, 1989; Nógrádi *et al.*, 1991). My results correspond to these data. The quantitative data show that the flight begins in summer, but the flight activity is larger in autumn.

Hydropsyche contubernalis (Fig. 1/8). Qualitative data are given about the flight of this species by Nógrádi and Uherkovich (1991) and Nógrádi *et al.* (1991), Uherkovich and Nógrádi (1990). The quantitative data show a flight activity pattern with one peak. Schmidt and Robert (1995) show two peaks in the flight activity pattern of *H. contubernalis* in Germany. In Hungary there is only one peak: this species has one generation here. Andrikovics and Ujhelyi (1983), Nógrádi *et al.* (1996), Nógrádi (1985), Kiss *et al.* (1999) give also good informations about the flight activity of this species.

Hydropsyche instabilis (Fig. 1/9). There are several records about the flight activity pattern. Kiss (1983) lists this species in the spring aspect and also in the summer aspect (1984, 1987). The flight period continues from summer to autumn (Kiss, 1979; Kiss *et al.*, 1999; Nógrádi *et al.*, 1996). In the Börzsöny Mountains, it is a summer species with a flight period of a medium length.

Hydropsyche saxonica (Fig. 1/10). In the Bakony (Nógrádi & Uherkovich, 1985), Mecsek Mountains (Nógrádi, 1987) and at Zselic Downs (Nógrádi & Uherkovich 1990) it is a typical summer species. There are also some data about the flight period in the works of Uherkovich and Nógrádi (1991), Kiss (1979), and Nógrádi *et al.* (1996). The species has a flight period of medium length.

Micropterna nycterobia (Fig. 1/11). The flight activity pattern of this species is very interesting. Kiss describes an autumn flight period for this species (Kiss, 1983, 1984). Other literature data indicate a long flight period from summer to autumn (Nógrádi et al., 1996; Kiss, 1979). Nógrádi *et al.* (1991) and Kiss *et al.* (1999) give an activity with summer interruption (Malicky, 1987). In the Börzsöny Mountains there are two flight activity periods with a summer interruption. The first flight starts in spring and stops in early summer, the second flight starts and stops in autumn.

Micropterna testacea (Fig. 1/12). Kiss (1979, 1984, 1987), Nógrádi *et al.* (1996) give information about the flight period of this species. It is an autumn caddisfly species with a short flight period.

Polycentropus flavomaculatus.(Fig. 1/13). There are some records about the flight activity of this species (Kiss, 1979, 1983; Nógrádi *et al.*, 1996). It is a summer species with a short flight period.

Potamophylax rotundipennis (Fig. 1/14). There are many quantitative (Nógrádi & Uherkovich, 1985; Nógrádi, 1987) and qualitative (Uherkovich & Nógrádi, 1991; Kiss, 1979; Nógrádi *et al.*, 1996; Kiss *et al.*, 1999) data about the flight activity. It is a autumn species with a long flight period in the Börzsöny Mountains.

Rhyacophila fasciata (Fig. 1/15). There are numerous qualitative (Nógrádi & Uherkovich, 1985; Nógrádi, 1987; Nógrádi & Uherkovich, 1991) and quantitative (Kiss, 1978, 1983, 1984, 1987; Nógrádi *et al.*, 1996; Kiss *et al.*, 1999) data about the flight of this species. In the Börzsöny Mountains it shows a continuous, long activity period.

Silo pallipes (Fig. 1/16). There are many data on the flight period of this caddisfly species (Kiss, 1979, 1983, 1984, 1987; Nógrádi *et al.*, 1996; Kiss *et al.*, 1999). In the Börzsöny Mountains it is a summer species with a flight period of medium length.

In conclusion, there are 9 caddisfly species with summer activities and 6 species with autumn activity on the one hand, there are 5 caddsfly species with short, 8 with medium and 2 with long swarming periods on the other hand (*Micropterna nycterobia* was not listed). This flight activity pattern represented catches of Trichoptera collected by light trapping in the Börzsöny Mountains at two permanent streams. This picture can be different at a temporary stream near these sampling sites (Sommerhauser *et al.*, 1997).

Acknowledgements. I thank Dr. Árpád Szentesi (Budapest) for his comments on the manuscript. This research was supported by the National Scientific Research Grant (OTKA), No. F026608.

REFERENCES

1. ANDRIKOVICS, S. & UJHELYI, S. (1983): Trichoptera of the Hungarian part of Lake Fertő (a faunistical and ecological treatise). – Fol. Ent. Hung., 44: 5-8.
2. KISS, O. (1979): The Trichoptera of the Bükk Mountains. – Acta Biol. Debrecina, 16: 45-55.
3. KISS, O. (1984): Fénycsapdával gyűjtött Trichopterák a Bükk-hegységi Vöröskő-völgyből. – Acta Acad. Paed. Agriensis, Nova Series, 17: 709-712.
4. KISS, O. (1987): A Bükk-hegységi Nagy-völgy (Nagyvisnyó) fénycsapdával gyűjtött Trichopterái. – Acta Acad. Paed. Agriensis, Nova Series, 18: 3-8.

5. KISS, O (1989): A Halesus digitatus (Schrank, 1781) életciklusa az észak-magyarországi Bükk-hegységi folyóvizekben. - Acta Acad. Paed. Agriensis, Nova Series, 19: 35-44.

6. KISS, O., ANDRIKOVICS, S., SZIGETVÁRI, G. & FISLI, I. (1999): Trichoptera from a light trap near the Eger Brook at Szarvaskő (Bükk Mountains, North Hungary). - Proc. 9th Internat. Symp. Trichoptera: 165-170.

7. MALICKY H. (1987): Anflugdistanz und Fallenfangbarkeit von Köcherfliegen (Trichoptera) bei Lichtfallen. - Jahresber. Biol. Stat. Lunz, 10: 140-157.

8. NÓGRÁDI, S. (1985): Caddisflies of the Barcs Juniper Woodland, Hungary (Trichoptera). - Dunántúli Dolgozatok, Természettud. Sorozat, 5: 117-134.

9. NÓGRÁDI, S. (1987): Caddisflies of the Eastern Mecsek Mountains, Hungary (Trichoptera), I. - Janus Pannonius Múz. Évk., 30-31: 11-22.

10. NÓGRÁDI, S., KISS, O. & UHERKOVICH, Á. (1996): The trichoptera fauna of the Bükk National Park. - In: Mahunka, Zombori & Ádám (eds): The fauna of the Bükk National Park, II. Magyar Természettud. Múz., Budapest: 397-409.

11. NÓGRÁDI, S. & UHERKOVICH, Á. (1990): The Trichoptera fauna of the Zselic Downs, Hungary. - Janus Pannonius Múz. Évk., 34: 15-38.

12. NÓGRÁDI, S. & UHERKOVICH, Á. (1991): Caddisflies of the Eastern Mountains, Hungary (Trichoptera), II. - Janus Pannonius Múz. Évk., 35: 19-25.

13. NÓGRÁDI, S., UHERKOVICH, Á. & ANDRIKOVICS, S. (1991): Foundation of the caddisfly (Trichoptera) fauna of the Visegrádi Mountains. - Opusc. Zool. Budapest, 24: 143-158.

14. SCHMIDT, C. & ROBERT, B. (1995): Naturkundliche Untersuchungen zum Naturschutzgebiet "Die Spey" (Stadt Krefeld, Kreis Neuss). - Natur am Niederrhein, 10: 62-68.

15. SOMMERHAUSER, M., ROBERT, B. & SCHUHMACHER, H. (1997): Flight periods and life strategies of caddisflies in temporary and permanent woodland brooks in the Lower Rhine area (Germany). - Proc. 8th Internat. Symp. Trichoptera: 425-433.

16. UHERKOVICH, Á. & NÓGRÁDI, S. (1990): The Trichoptera fauna of the Great Hungarian Plain, Hungary. - Fol. Hist.-nat. Mus. Matr., 15: 43-75.

16. UHERKOVICH, Á. & NÓGRÁDI, S. (1991): Trichoptera fauna of a typical cultivated region of the Carpathian Basin by light trap examination. - Janus Pannonius Múz. Évk., 35: 27-32.

17. UHERKOVICH, Á. & NÓGRÁDI, S. (1992): The Trichoptera fauna of Nagyszombatfa, West Hungary. - Janus Pannonius Múz. Évk., 36: 13-30.

Diversity of testacean Protozoa in River Tisza after a cyanide and metall pollution at the beginning of year 2000 Preliminary study

By

J. K. TÖRÖK*

Abstract. Inspite of the damageous environmental perturbation suffered early in 2000, River Tisza is inhabited by prospering protozoan assemblages with 80 testacean species detected during a sampling tour along the upper and middle course of the river in July, 2000. *Cochliopodium actinophorum* Auerbach, *Difflugia amphoralis* Cash and *Lecythium hyalinum* Hertwig & Lesser are new species to the Hungarian fauna.

The severe cyanide and metall pollution of Rivers Szamos and Tisza early in 2000 directed the attention of scientists toward the study of biodiversity of these rivers to ascertain the degree of damage concerning living organisms. Some microfauna elements, the protozoans, mainly testate amoebae and zooflagellates, to a lesser extent the ciliates, too, have been subject to various former faunistic and ecological investigations (Gál, 1961-81; Szabados, 1966; Jósa, 1981).

The aim of the present study is to establish the testacean species diversity in six different locations including polluted and non-polluted courses of the Szamos-Tisza water system, furthermore an oxbow as a lentic controll area. The following results are the first ones of a two-year survey which is intended to monitor testacean diversity through regular, seasonal sampling of the area.

Materials and methods

Sampling was carried out on 17-18th July, 2000. The sampling points were set so as to avoid anthropogenic influence as much as possible. The first site was in the Upper-Tisza, above the polluted course (lotic controll area, above the mouth of River Szamos) in the vicinity of the small village Jánd. The next one was in River Szamos at Olcsva, close to the river's mouth upstreams. The forthcoming lotic sites were in the Middle-Tisza, downstreams Szabolcs,

**Júlia Katalin Török*, ELTE Állatrendszertani és Ökológiai Tanszék (Systematic Zoology and Ecology of the Eötvös Loránd University), 1088 Budapest, Puskin u. 3, Hungary.

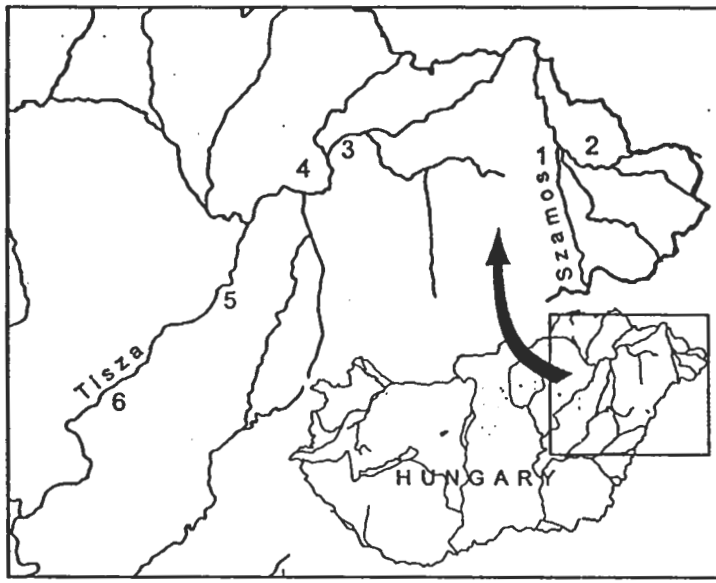


Fig. 1. Location of the sampling sites

Tiszacsege and south of Abádszalók. An oxbow was sampled as a lentic controll area in the vicinity of Tiszaladány (Fig. 1). All the samples were collected inshore, within 50 cm distance from the shoreline. Waterdepth varied within ca. 20-40 cm.

Characterization of the sampled habitat types is described according to the locations in Table 1.

Six subsamples were taken from each site to assess maximum variance in species composition. One subsample from each set was preserved alive, the remaining five were fixed in 4 % formaldehyde solution and stained with bromphenol-blue to distinguish easily between living cells and empty shells. The samples were examined under lightmicroscope using brightfield, nomarski or phase technics. Metric multidimensional scaling (Syntax, Podani, 1994) was applied to assess the relation of the sampled localities to each other on the basis of the presence-absence of testacean taxa.

Results

Altogether 80 testacean species and subspecies have been detected (Table 2), Fig. 2 shows the distribution of genera among the sampling sites. The Upper-

Tisza (lotic controll area) proved to be the richest site with as many as 40 taxa, followed by the oxbow at Tiszaladány (lentic controll, 29 taxa). The River Szamos and the Szabolcs samples yielded 28 and 26 taxa, respectively, while the two remaining ones counted not more than 15 taxa (Tiszacsege) and 6 taxa (Abádszalók). *Cochliopodium actinophorum* Auerbach, 1853, *Difflugia amphoralis* Cash, 1909 and *Lecythium hyalinum* Hertwig & Lesser, 1874 are first records in Hungary (Fig. 3).

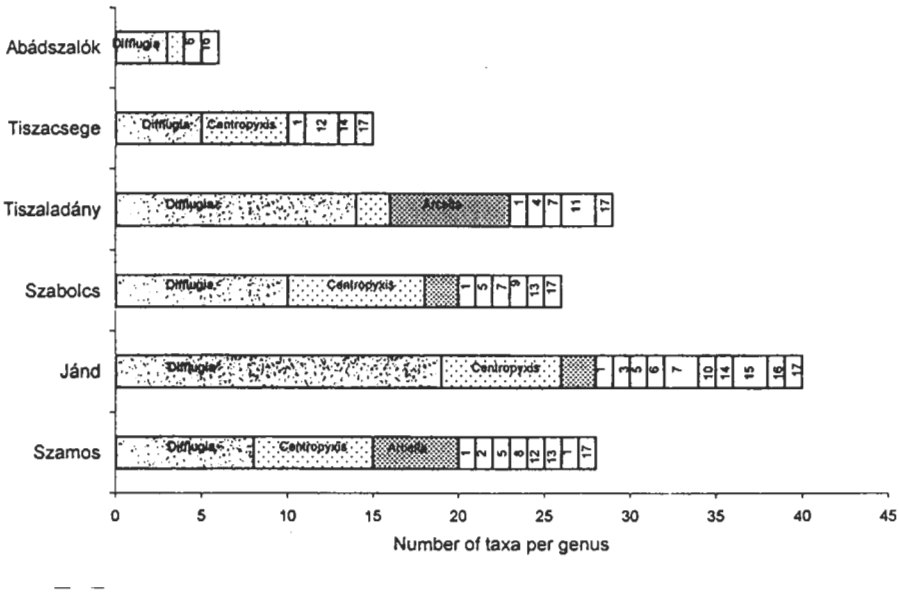


Fig. 2. Distribution of genera among sampling sites. (1: *Clypeolina*, 2: *Cochliopodium*, 3: *Cryptodifflugia*, 4: *Cucurbitella*, 5: *Cyclopyxis*, 6: *Cyphoderia*, 7: *Euglypha*, 8: *Filosea*, 9: *Lecythium*, 10: *Lesquereusia*, 11: *Netzelia*, 12: *Phryganella*, 13: *Plagiopyxis*, 14: *Pontigulasia*, 15: *Pseudodifflugia*, 16: *Trinema*, 17: *Zivkovicia*)

The ordination plot reflects the similarity of the sampling localities based on the qualitative composition of their testacean assemblages (Fig. 4). The lentic controll area and the last two sampling sites are plotted far from all the others, while the Upper-Tisza (lotic controll), Szamos and Szabolcs samples are grouped together.

Table 1. Description of the sampling sites

Location	Sampled habitat	Bank	Location	Sampled habitat	Bank
1. Szamos	sediment (mud)	flat	4. Tiszaladány	sediment (mud), biotecton	flat
2. Jánd	sediment (mud)	flat	5. Tiszacsege	sediment (sand), biotecton	steep
3. Szabolcs	sediment (mud), biotecton	flat	6. South from Abádszalók	sediment (sand)	steep

Fig. 3. *Difflugia amphoralis* Cash, 1909, a testacean species new to the Hungarian fauna

Discussion

Gál (1961-1981) identified 46 taxa during his investigations in nearly the same courses of the Tisza and the Szamos. 22 of them occurred in the present study, which means that as a whole 104 testacean taxa have been found in this water-system.

The species list reflects the usual composition of aquatic testacean assemblages. The lotic controll area yielded the highest number of testacean taxa (40), however, 11 of them occurred as one specimen only, 4 of which not identified *Difflugia* species. The large number of single specimens of different testacean species is typical for the running water habitat. The lentic controll site can be characterized with some large-sized *Difflugia* species which were not found at any other sites. *Difflugia bicruris, D. lithoplites, D. parva* and *D. viscidula* with their more than 250 μ body length are among the largest testacean species. Their presence is typical for standing waters.

Similarity composition of the Szamos - Jánd (control!) - Szabolcs samples suggests that the pollution did not influence strongly the species composition of the testacean assemblages.

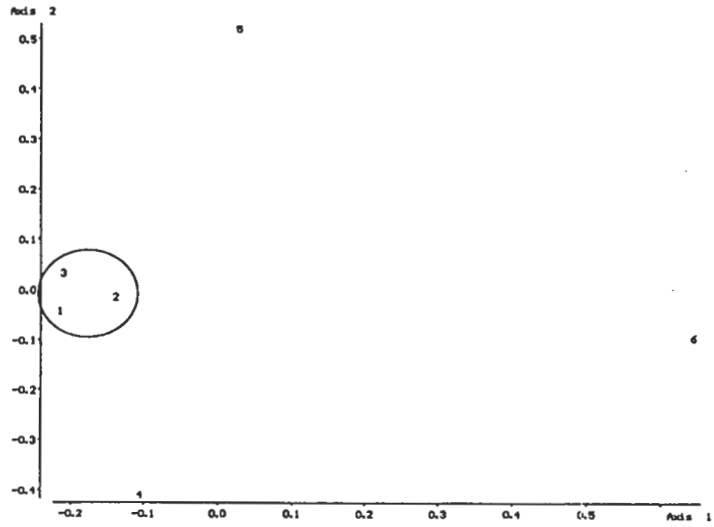


Fig. 4. Ordination of sampling sites according to the species composition of their testacean assemblages

The last two sites were strikingly poor in testacean taxa, which may rather be assigned to the sampling conditions (steep banks, sand as prevalent compound in the sediment, beginning of flood) than any kinds of pollution.

Concerning habitat types, only the sediment seemed to have considerable amount of species as well as individuals in the running water samples. In the oxbow, however, many testaceans - especially *Arcella* spp. and *Netzelia* spp. - occurred on the surface of the various waterplants.

Having encountered diverse testacean fauna in the polluted sections of Rivers Tisza and Szamos it is to be hoped that the industrial pollution did not give rise to a drastic reduction in the microfauna. Stable persistence of the microfauna - fundamental component in the aquatic foodweb - is a hopeful sign for the recovery of higher organisms. Further results based on quantitatve data may give deeper insight into the community structure of the testate amoebae in this region.

Acknowledgement. This work was performed with financial support for the Department of Systematic Zoology and Ecology of the Eötvös Loránd University by a grant from the Ministry of Environment (No. 1543/2).

Table 2. List of testate amoebae taxa. Sz = River Szamos, T1 = Jánd, T2 = Szabolcs, T3 = , Tiszaladány, T4 = Tiszacsege, T5 = south from Abádszalók. Asterisks stand for taxa found by Gál (1961-1981)

	Taxa	Sz	T1	T2	T3	T4	T5
*	*Arcella discoides* Ehrenberg, 1872				+		
*	*Arcella hemisphaerica* Perty, 1852	+		+	+		
	Arcella hemisphaerica intermedia Deflandre, 1928	+			+		
	Arcella megastoma Penard, 1902		+				
	Arcella polypora Penard, 1890				+		
	Arcella rotundata Playfair, 1918	+			+		
	Arcella rotundata stenostoma Deflandre, 1928	+	+	+	+		
*	*Arcella vulgaris* Ehrenberg, 1832	+			+		
*	*Centropyxis aculeata* (Ehrenberg) Stein, 1857	+	+	+		+	
	Centropyxis aculeata grandis Deflandre, 1929					+	
	Centropyxis aerophila Deflandre, 1929	+	+	+			+
*	*Centropyxis constricta* Deflandre, 1929	+	+	+	+		
*	*Centropyxis discoides* Penard, 1902	+	+	+		+	
	Centropyxis ecornis Ehrenberg, 1832	+		+	+	+	
	Centropyxis elongata (Penard) Thomas, 1959			+			
	Centropyxis gibba inermis Bartos, 1940					+	
	Centropyxis laevigata Penard, 1890		+				
	Centropyxis marsupiformis Deflandre, 1929	+	+	+			
	Centropyxis aerophila sphagnicola Deflandre, 1929	+	+	+			
	Clypeolina marginata Penard, 1902	+	+	+	+	+	
	Cochliopodium actinophorum Auerbach, 1856	+					
	Cryptodifflugia sp.		+				
	Cucurbitella mespilliformis Penard, 1901				+		
	Cyclopyxis kahli Deflandre, 1929	+	+				
	Cyclopyxis sp.			+			
*	*Cyphoderia ampulla* Ehrenberg, 1840		+				
*	*Cyphoderia laevis* Penard, 1902						+
*	*Difflugia acuminata* Ehrenberg, 1838		+		+		
	Difflugia amphoralis Cash & Hopkinson, 1909		+				+
	Difflugia angusticollis Stepanek, 1952				+		
	Difflugia bicornis Penard, 1890		+	+			
	Difflugia bicruris G.L. & Thomas, 1959				+		
*	*Difflugia corona* Wallich, 1864		+		+		
*	*Difflugia curvicaulis* Penard, 1899		+		+		
*	*Difflugia elegans* Penard, 1890	+	+	+			
	Difflugia elegans teres Penard, 1899	+					
	Difflugia fallax Penard, 1890	+					
	Difflugia gassowskyi (Gassowsky) Ogden, 1893		+		+		
	Difflugia glans Penard, 1902	+		+			
*	*Difflugia gramen* Penard, 1902	+	+	+	+	+	+
	Difflugia labiosa Wailes, 1919		+			+	
	Difflugia lacustris (Penard) Ogden, 1983		+				

Table 2. (cont.)

	Taxa	Sz	T1	T2	T3	T4	T5
	Difflugia limnetica (Levander) Penard, 1902		+	+	+		
	Difflugia linearis (Penard) G.L. & Thomas, 1958				+		
	Difflugia lithophila (Penard) G.L. & Thomas, 1958		+	+			
	Difflugia lithoplites Penard, 1902				+		
*	*Difflugia lobostoma* Leidy, 1879	+	+	+	+		
*	*Difflugia mamillaris* Penard, 1893	+	+				
	Difflugia manicata Penard, 1902				+		
	Difflugia minuta Rampi, 1950	+					
*	*Difflugia oblonga* Ehrenberg, 1838		+			+	
	Difflugia oblonga gigantea Leidy, 1879			+			
	Difflugia parva (Thomas) Ogden, 1983				+		
	Difflugia viscidula Penard, 1902				+		
	Difflugia sp. 1					+	
	Difflugia sp. 2			+		+	
	Difflugia sp. 3		+				
	Difflugia sp. 4						+
	Difflugia sp. 5		+				
	Difflugia sp. 6		+				
	Difflugia sp. 7		+				
	Difflugia sp. 8			+			
*	*Euglypha alveolata* Dujardin, 1841		+	+			
	Euglypha acanthophora Ehrenberg, 1843				+		
*	*Euglypha laevis* Perty, 1849		+				
	Filosea sp.	+					
	Lecythium hyalinum Hertwig & Lesser, 1874			+			
	Lesquereusia modesta Rhumbler, 1855		+				
*	*Netzelia oviformis* (Cash) Ogden, 1979				+		
	Netzelia tuberculata (Wallich) Ogden, 1979				+		
	Phryganella hemisphaerica Penard, 1902	+				+	
*	*Phryganella paradoxa* Penard, 1902					+	
	Plagiopyxis declivis Thomas, 1955			+			
	Plagiopyxis intermedia Bonnet, 1959	+					
	Pontigulasia incisa Penard, 1893		+			+	
	Pseudodifflugia gracilis Schlumberger, 1855	+	+				
	Pseudodifflugia fulva Archer, 1872		+				
*	*Trinema enchelys* Ehrenberg, 1838						+
*	*Trinema lineare* Penard, 1890		+				
	Zivkovicia compressa (Carter) Ogden, 1983	+	+	+	+	+	

REFERENCES

1. GÁL, D. (1961): Das Leben der Tisza, X. Die Rhizopodenfauna der auf ungarischem Boden fliessenden oberen Strecke der Tisza im Jahre 1959/60. – Acta Univ. Szeged. Biol., 7: 77-83.
2. GÁL, D. (1970-71): Die Rhizopodenfauna der ungarischen Strecke der Theiss und des Mündungsteiles ihrer Nebenflüsse. – Tiscia (Szeged), 6: 31-40.
3. GÁL, D. (1972): Rhizopodenfauna der Theiss-Strecke über der im Bau begriffenen II. Theiss-Stufe. – Tiscia (Szeged), 7: 29-35.
4. GÁL, D. (1981): Studies on the benthic Testacea fauna in the longitudinal section of the Tisza. – Tiscia (Szeged), 16: 131-140.
5. JÓSA, Z. (1981): Studies on the Ciliata fauna of sediment samples from the Hungarian reach of the Tisza. – Tiscia (Szeged), 16: 11-154.
6. PODANI, J. (1994): Multivariate analysis in ecology and systematics. – SBP Academic Publishing, The Hague, pp. 316.
7. SZABADOS, M. (1966): Das Leben der Tisza. Protisten: Flagellaten. – Tiscia (Szeged), 2: 13-24.
8. TÖRÖK, J. K. (1997): Distribution and coenotic composition of benthic testaceans (Protozoa, Rhizopoda) in the abandoned main channel of River Danube at Szigetköz (NW-Hungary). – Opusc. Zool. Budapest, 29-30: 141-154.

Temporal-spatial patterns of aquatic and semi-aquatic Heteroptera (Gerromorpha, Nepomorpha) at Lake Fertő, Hungary

By

I. VARGA* and L. HUFNAGEL**

Abstract. In the framework of zoological studies of decomposing reed litter on Lake Fertő/Neusiedler See from 1995 till 1999, we sampled the macroinvertebrate and Heteroptera fauna as well. Studies show the presence of 12 Gerromorpha and 18 Nepomorpha, altogether 30 species. We evaluated the spatial-temporal pattern of Heteroptera communities using multiple variable statistical methods and some simple diversity variables.

Lake Fertő (Neusiedler See) is situated on the Austro-Hungarian border, and has a special position among lakes in Hungary. It is a real lowland saline lake (sodium-magnesium-hydrogencarbonate-sulphate type), which, given its extreme shallowness (average deep is 1 meter only), is characterized by the strong influence of outer environmental factors. Therefore it is largely unstable considering its physical, chemical and biological features (Szabó, 1962; Varga, 1962). More than 80% of the Hungarian part (75 km^2) of the lake is covered by reeds. The reeds reach deep into the lake area and divide the open water into several parts of different size, forming bays and limnologically special, so called „inner lakes", which are very different from one another from a hydrological point of view, depending on where they are in the lake and how isolated they are (Dinka & Berczik, 1992). The large reeds are laced with canals formed for the purpose of reed cultivation.

Lake Fertő is part of the Fertő-Hanság National Park, declared as a Biosphere Reserve by UNESCO, which makes it especially important to discover the natural values and fauna of the lake as close as possible. Studying macroinvertebrate communities, and especially Heteroptera, is becoming more and more important in limnological research given that these groups are good indicators of environmental changes, thus they can be utilized in surveying the quality of habitats and the water itself (Hufnagel *et al.*, 2000 b; Savage, 1982).

**Ildikó Varga,* ELTE Állatrendszertani és Ökológiai Tanszék (Department of Systematic Zoology and Ecology of the Eötvös Loránd University), 1088 Budapest, Puskin u. 3, Hungary.

***Levente Hufnagel,* ELTE Állatrendszertani és Ökológiai Tanszék, MTA Zootaxonómiai Kutatócsoport (Department of Systematic Zoology and Ecology of the Eötvös Loránd University, Zootaxonomy Rersearch Group of the Hungarian Academy of Sciences), 1088 Budapest, Puskin u. 3, Hungary.

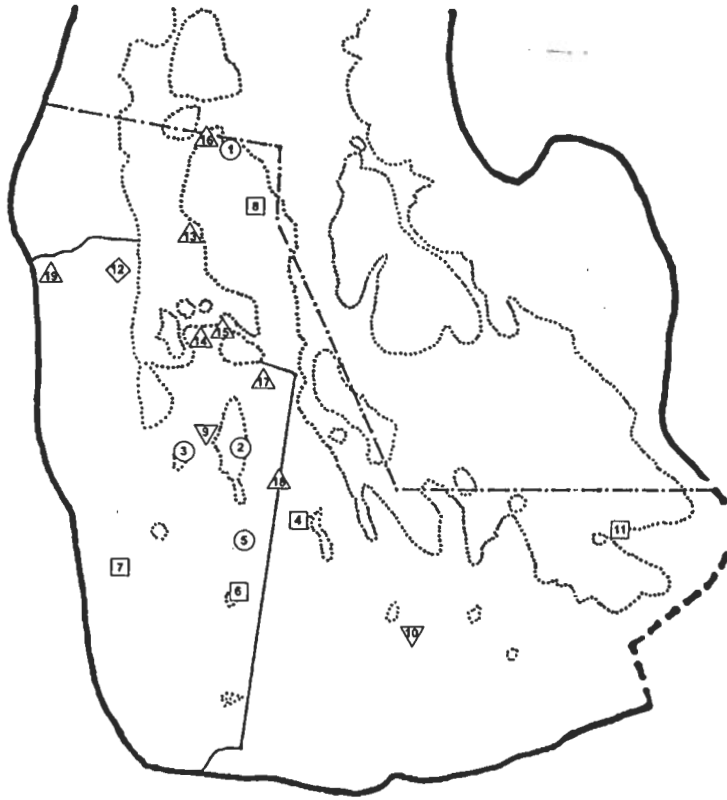


Fig. 1. Sampling sites: 1: B0, 2: Herlakni, 3: Kisherlakni, 4: Hidegségi, 5: Átjáró Ponds, 6: Nagyhatártisztás, 7: Pitner beach, 8: Fertőrákosi Bay-Keresztárok Canal, 9: Herlakni Canal, 10: Homoki ferde Canal, 11: Madárvárta Bay, 12: Nádas 3, 13: Fertőrákosi Bay, 14: Kladler, 15: Gémes Ponds, 16: B0, 17: Püspök, 18: Bozi Canals, 19: next to the Fertőrákos Hydrometeorological Station. (O - macroinvertebrates in 1995-96, 1998-99 and Heteroptera samples, □ - macroinvertebrates in 1995-96, Δ - Heteroptera samples, ∇ - macroinvertebrates in 1995-96 and Heteroptera samples, ◊ - macroinvertebrates in 1998-99 and Heteroptera samples)

The first detailed, comprehensive study was delivered by Géza Horváth (1923), who collected samples in the area in the 1920's and summarized earlier studies and museological data.

Macroinvertebrate studies done much later provided new data about the Heteroptera fauna of the lake. Andrikovics collected macroinvertebrates in submersed macrophyton stands and reeds in the 1970's (Andrikovics, 1973, 1978, 1979a,b, 1980). As of 1995, having joined the European reed research project "EUREED", studies are aiming at a still unknown habitat: macroinvertebrate communities of decomposing reed litter (Varga, 1997; Varga *et al.*, 1998).

One aim of the studies is to survey the basic state of the fauna, which is of primary interest from the nature conservation, water quality control and reed

decomposition studies point of view and serves as a basis for any further ecological research. Based on data sampled in 1998-1999, our further goal was to compare the Heteroptera fauna with data from earlier studies and to find out more about seasonal differences and abundance status of communities.

Material and methods

From 1995 till 1999, we sampled the macroinvertebrate and Heteroptera fauna of Lake Fertő. Sampling occasions can be classified into 3 types:

(1) In 1995-1996 we did pilot study of macroinvertebrates living on decomposing reed litter.

(2) In 1998-1999 we took samples from 5 sites (B0, Átjáró, Kisherlakni, Herlakni Ponds, Nádas 3) of the lake, washed and collected by net from decomposing reed litter 6 times per year (in April, May, June, July, September and October 1998 and in April, June, July, August, September and October 1999). Samples were taken from sheaves of reed placed in spring 1998, except from site B0 where we sampled the fauna from reed piled up in a natural way.

(3) Parallel to the sampling from decomposing reed litter, we collected Heteroptera using nets at the 5 permanent sampling sites (see above) and 9 other sites (Fertőrákos Bay, Kladler, Gémes Ponds, near Fertőrákos Hydrometeorological Station, B0, Herlakni, Bozi, Püspök, Homoki ferde Canals).

In the comprehensive description of the fauna we included all data, but coenotic evaluation is based exclusively on data from years 1998-1999.

At permanent sampling sites some hydrochemical parameters were measured using the WTW portable field equipment (water temperature, pH, dissolved O_2, conductivity).

Description and characteristics of sampling sites

I. Permanent sampling sites (Fig. 1)

B0 (B0): 100,m from the Austro-Hungarian border, the site is situated on the northernmost part of a long reed isle, which is in direct contact with open water. Thus, the site is heavily affected by the prevailing northern - north-western winds. Samples taken from single reeds pushed against the reed wall (outer B0) were handled separately from the ones taken from coated (periphyton) reed stems (inner B0) growing in a small (a couple of square metres), more open area.

Herlakni Pond (HER): the largest inner lake of the Hungarian part of the lake with an area of 53.77 ha. Samples were taken in the middle part of the eastern shoreline of the Pond.

Kisherlakni Pond (KHR): a particularly closed inner lake, situated south-west from Herlakni Pond, with an area of only 2.07 ha.

Table 1. Hydrochemical parameters of regularly sampled sites with minimum and maximum values

Sites	pH	Dissolved O_2 mg/l	Dissolved O_2 %	Conductivity µS/cm
B0	8.53-9.0	5.45-10.1	65.9-102	1537-2250
Átjáró Pond	8.1-8.5	2.13-7.33	26.5-69.2	1583-2560
Kisherlakni Pond	7.88-8.4	0.73-10.2	9.4-95.6	1669-2850
Nádas 3	8.38-8.8	1.19-11.89	12.1-145	1839-3190

Átjáró Pond (ÁtjN): inner lake of 2.53 ha, samples were taken at the angler-stage at the eastern shoreline. On five occasions, we have taken samples also from rhizomes (ÁtjR) floating on the water surface.

Nádas 3 (N3): it is a dieback reed stand at the western shore of the lake, 300 metres from the Fertőrákos Hydrometeorological Station.

II. Occassional sampling sites (Fig. 1)

Occassional sampling sites can be put into two basic groups: open water areas and canals. The Fertőrákos Bay (Fö) is the largest contiguous open water area, at the southernmost part of which there are the Kladler (Kla) and the Gémes (Gém) Ponds to be found. Out of canals, the Herlakni (Hcs) and the B0 (B0cs) Canals run from east to west, while the Püspök (Pcs), the Homoki ferde (Homoki) and the Bozi (Bozi) Canals are running from north to south. The area close to the Fertőrákos Hydrometeorological Station (Frá) is a special one given that it is not covered permanently by water.

During 1995-96, we sampled the Hidegségi Pond (HID), the Nagyhatártisztás (NHA), the Pitner Beach (Pitner), the Fertőrákos Bay-Keresztárok Canal (Fká), the Madárvárta Bay (Madár) (Fig. 1), which were omitted from the later survey.

Table 1 shows a few hydrochemical characteristics of permanent sampling sites, indicating the range of measured values.

For identification of aquatic and semi-aquatic Heteroptera the following keys were used: Benedek (1969), Hufnagel & Vásárhelyi (2000), Jansson (1969, 1986), Savage (1989), Soós (1963), Stusák (1980), Vásárhelyi (1990) and Vepsalainen & Krajewski (1986). Names of species are consistently provided according to Aukema & Rieger (1995).

Data were processed using multiple variable methods (classifications and ordinations), out of which we publish only a few in this paper, but all of them were used to draw the conclusions. For multiple variable analyses we used SYN-TAX 5.1 software (Podani, 1993a,b). Detailed description of methods used can be found in Podani (1997). To describe diversity we have chosen four simple measures with the intention of projecting them to ordinations. Apart from number of species and individuals we used the Berger-Parker index to describe uniformity (index 1 means dominance of the dominant species), while we also calculated relative abundance of species (number of species per a set number of individuals, see Hufnagel et al., 2000a). The complete list of species was put on a stable zoocoenotic state space (Gaál & Hufnagel, 1999; Hufnagel et al., 1999a,b, 2000b), which makes it possible to

compare the surveyed area with other areas in the country that have undergone detailed survey (Bakonyi & Vásárhelyi, 1993b; Csörgits & Hufnagel, 2000a,b; Hufnagel, 1998; Moldoványi, 1977, 1984).

Results and discussion

Faunistic data

To keep it short, the list of species contains the name of the species, the abbreviated name of the sampling site (which can be found at the description of the sites) and the date (year and month) of sample taken. As classification of Heteroptera larvae has been difficult until recently, please note that the publishment of data about larvae fills a knowledge gap.

Microvelia sp. larva: KHR VI. 1998; N3 VI. 1998; ÁtjR VII. 1998; B0 VII. 1999

Microvelia reticulata: KHR V. 1995, IV., V., VII. 1998, IV., VII. 1999; ÁtjN V. 1995, IV., VII. 1998; B0 V., VI. 1998, VII. 1999; Pcs VI. 1999; N3 V., X. 1998, IV., VII. 1999; Hcs X. 1998; Frá IV. 1999; HER VII. 1999; Bozi VII. 1999; HID V. 1995, X. 1996; Madár VIII. 1995; Fká VIII. 1995

Microvelia reticulata larva: KHR VII. 1999; N3 X. 1998, VII. 1999; Hcs X. 1998; Madár VIII. 1995

Microvelia brunoi: N3 X. 1998, IV. 1999; Bozi VII. 1999

Mesovelia furcata: Pcs VI. 1999

Mesovelia furcata larva: HER VII. 1999; Pcs VI. 1999; KHR X. 1998

Hydrometra sp. larva: Hcs X. 1998

Hydrometra stagnorum: HER IV. 1999; Kla VI. 1999

Plea minutissima: B0 V. 1995, V., VI., VII., X. 1998, IV., VI., VII. 1999; KHR V., VI. 1998, IV., VI., VII. 1999; ÁtjN V., VIII. 1995, V. 1996, V., VI., VII. 1998, VI. 1999; N3 V., VI., IX., X. 1998, IV., VII. 1999; ÁtjR VI., VII. 1998; HER V. 1996, VI., VII. 1998, VI., VII. 1999; Fö VII. 1998; Hcs VIII. 1995, V. 1996, X. 1998; Pcs X. 1998, VI. 1999; Frá IV. 1999; Bozi VII. 1999; HID V., VIII. 1995, VII. 1996; Homoki VIII. 1995

Plea minutissima larva: KHR VI., VII. 1998, VII. 1999; B0 VII., X. 1998; ÁtjN VIII. 1995, VII. 1998; Bozi VII. 1999; N3 VI., X. 1998, VII. 1999; HER VII., IX. 1998, VII. 1999; Hcs VIII. 1995, X. 1998; Homoki VIII. 1995

Corixidae larva: Hcs V. 1996, X. 1998; B0 VIII. 1995, VI., VII. 1999; NHA V. 1995; Fká VIII. 1995; HER VIII. 1995, VII. 1996; KHR V. 1996; Pitner VII. 1996; Madár VIII. 1995; HID V. 1995, VII. 1996; ÁtjN V., VIII. 1995, V. 1996

Callicorixa praeusta: KHR VI. 1999

Cymatia coleoptrata: B0 VIII. 1995, IV., VI., VII. 1998, IV., VII., X. 1999; KHR V., VI., VII. 1998, IV., VI., VII., X. 1999; ÁtjN VIII. 1995, VI., VII. 1998, IV., VII., X. 1999; N3 VI., X. 1998, IV., VII. 1999; HER VIII. 1995, IV., VI., VII., IX. 1999; Hcs X. 1998; Pcs IV. 1999; Kla VI. 1999; Bozi VII. 1999; HID V., VIII. 1995, VII., X. 1996; Homoki VIII. 1995; Madár VIII. 1995

Cymatia coleoptrata larva: KHR V., VI., VII. 1998, VI., VII. 1999; N3 V., VI., X. 1998, VII. 1999; ÁtjN VI., VII., IX. 1998, VII. 1999; ÁtjR VII. 1998; B0 VII. 1998; HER IV., VII., IX. 1999; Hcs X. 1998; Kla VI. 1999; Pcs VI. 1999; Gém VI. 1999; Bozi VII. 1999

Cymatia rogenhoferi: Frá IV. 1999

Hesperocorixa linnaei: ÁtjN VIII. 1995, IV. 1998, IV., X. 1999; KHR VIII. 1995, VI., VII. 1998, IV., VII., IX., X. 1999; Gém VI. 1999; N3 VI., X. 1998, IV., VII. 1999; B0 VII., X. 1998, IV., VII., X. 1999; Hcs X. 1998; Pcs IV. 1999; HER IV., VII. 1999; Bozi VII. 1999; HID V. 1995, VII., X: 1996; Madár VIII. 1995

Hesperocorixa linnaei larva: ÁtjN V. 1998, VI. 1999; N3 V., VI. 1998, VII. 1999; KHR VI: 1998, VI. 1999; ÁtjR VII. 1998; HER IV., VI. 1999

Hesperocorixa sahlbergi: KHR VII. 1998

Micronecta sp. larva: B0 IV. 1998

Micronecta scholtzi: B0 IV., V., VI., VII., IX. 1998, VI., VII., IX. 1999; HER IV., VII. 1999; Fö VII. 1998; Fká VIII. 1995

Micronecta scholtzi larva: B0 V., VII. 1998, IV., VII. 1999

Micronecta pusilla: B0 VI., VII. 1999; KHR IX. 1999; Kla VI. 1999; Pcs VI. 1999; Gém VI. 1999

Micronecta pusilla larva: B0 VII. 1999

Sigara falleni: B0 X. 1999

Sigara limitata: HER VII. 1999

Sigara striata: KHR V., VI., VII. 1998, VI., VII., IX., X. 1999; B0 VI., VII., IX., X. 1998, IV., VI., VII., IX., X. 1999; N3 VI. 1998, VII. 1999; ÁtjN VII., X: 1998, VI. 1999; HER IV., VI., VII. 1999; Fö VII. 1998; Frá IV. 1999; Kla VI. 1999; Gém VI. 1999

Sigara striata larva: KHR V., VII: 1998, VI., VII. 1999; N3 V., VI. 1998, VII. 1999; B0 VI., VII., IX. 1998, VII., IX., X. 1999; ÁtjN VI., VII. 1999; HER IV., VII. 1999; Pcs VI. 1999; Gém VI. 1999

Sigara lateralis: B0 IX. 1998, VI., X. 1999; Pcs IV. 1999; Homoki IV. 1999; B0cs IV. 1999

Sigara lateralis larva: KHR V. 1998

Notonecta sp. larva: B0 V. 1998; HER IV. 1999; ÁtjN IV. 1999; KHR IV. 1999

Notonecta glauca larva: N3 VII. 1999

Ilyocoris cimicoides: KHR IV., IX. 1998, IX., X. 1999; Hcs X. 1998; N3 IX., X. 1998, VII. 1999; ÁtjN VIII. 1995, X. 1998; HER X. 1999; HID V., VIII. 1995; Homoki VIII. 1995; Madár VIII. 1995

Ilyocoris cimicoides larva: B0 VI. 1998, VII. 1999; N3 VI. 1998, VII. 1999; ÁtjN VIII. 1995, VI., VII. 1998; KHR VII., IX. 1998, VII. 1999; ÁtjR VI., VII. 1998; HER VI., VII., IX. 1999; Kla VI. 1999; Pcs VI. 1999; Gém VI. 1999; HID VIII. 1995, VII. 1996; Fká VIII. 1995; Hcs V. 1996

Ranatra linearis: ÁtjN IX., X. 1998; B0 VII. 1999; KHR X. 1999; HER X. 1999; HID VIII. 1995; Madár VIII. 1995

Table 2. Comparison of species lists obtained during different faunistic investigations in Lake Fertő

Taxa	Horváth 1923	Andrikovics 1979	Decomposing reed litter 1995-1999	Faunistic Heteroptera collecting 1998-99
GERROMORPHA				
Mesoveliidae				
Mesovelia furcata Mulsant & Rey, 1852				+
Hydrometridae				
Hydrometra sp. larva				+
Hydrometra stagnorum (Linnaeus, 1758)	+			+
Veliidae				
Microvelia sp. larva			+	+
Microvelia reticulata (Burmeister, 1835)			+	+
Microvelia bruenoi Drake 1920			+	+
Velia currens (Fabricius, 1794)	+			
Gerridae				
Aquarius paludum paludum (Fabricius, 1794)	+		+	+
Gerris argentatus Schummel, 1832	+		+	+
Gerris asper (Fieber, 1860)	+			+
Gerris lacustris (Linnaeus, 1758)	+		+	+
Gerris odontogaster (Zetterstedt, 1828)	+			+
Gerris thoracicus Schummel, 1832	+			
Limnoporus rufoscutellatus (Latreille, 1807)	+			
NEPOMORPHA				
Nepidae				
Nepa cinerea Linnaeus, 1758	+		+	
Ranatra linearis (Linnaeus, 1758)	+	+	+	+
Corixidae				
Micronecta sp. larva			+	
Micronecta pusilla (Horváth, 1895)		+		+
Micronecta scholtzi (Fieber, 1860)		+	+	+
Cymatia coleoptrata (Fabricius, 1777)	+	+	+	+
Cymatia rogenhoferi (Fieber, 1864)				+
Callicorixa praeusta praeusta (Fieber, 1848)				+
Corixa punctata (Illiger, 1807)	+			
Corixidae larva		+	+	+
Hesperocorixa linnaei (Fieber, 1848)	+	+	+	+
Hesperocorixa sahlbergi (Fieber, 1848)	+			+
Paracorixa concinna concinna (Fieber, 1848)	+	+		
Sigara falleni (Fieber, 1848)				+
Sigara lateralis (Leach, 1817)	+		+	+
Sigara limitata limitata (Fieber, 1848)				+
Sigara striata (Linnaeus, 1758)	+	+	+	+
Naucoridae				
Ilyocoris cimicoides cimicoides (Linnaeus, 1758)	+	+	+	+
Notonectidae				
Notonecta sp. larva		+	+	+
Notonecta glauca glauca Linnaeus, 1758	+	+		+
(*Notonecta glauca* var. *furcata* Fabricius, 1777)	(+)			
Pleidae				
Plea minutissima minutissima Leach, 1817	+	+	+	+
Number of species	21	10	15	24
ΣΣ				30

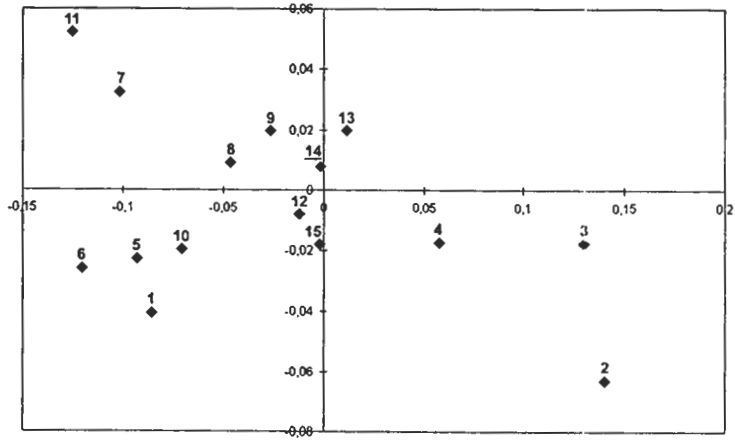


Fig. 2. Abstract spatial representation of coenotic states based on some regularly investigated Hungarian aquatic biotopes. 1: Gubacsi Ridge, 2: Caprera, 3: Szilas, 4: Gyál Streams, 5: Duna-Tisza Canal, 6: Szigetcsép Oxbow, 7: Lake Balaton 1920, 8: Lake Balaton 1980, 9: Rakaca Barrage,n 10: Hortobágy River, 11: Hortobágy Fishpond, 12: Nyéki Oxbow, 13: Naplás Pond, 14: Lake Fertő, 15: Szigetköz

Ranatra linearis larva: ÁtjR VII. 1998; HER VII. 1999

Nepa cinerea larva: B0 VII. 1999

Aquarius paludum: Frá IV. 1999

Gerris argentatus: ÁtjN VII. 1999; N3 X. 1998, IV., VII. 1999; Pcs IV., VI. 1999; Homoki IV. 1999; Bozi VII. 1999; HER IV., VI., VII. 1999; Frá IV. 1999; B0cs IV. 1999; Kla VI. 1999

Gerris argentatus larva: B0 IX. 1999; N3 X. 1998; Hcs X. 1998; ÁtjN VI. 1999; Pcs VI. 1999

Gerris asper larva: KHR VI., VII., IX. 1999; HER VI., VII. 1999; Gém VI. 1999

Gerris lacustris: B0 VII. 1998

Gerris lacustris larva: KHR VII. 1998, VI. 1999; HID VII., X: 1996; ÁtjN V., VIII. 1995; Madár VIII. 1995; Fká VIII. 1995

Gerris odontogaster: HER IV. 1999; Frá IV. 1999

Gerris odontogaster larva: KHR VII. 1999; B0 VI. 1999; N3 VII. 1999

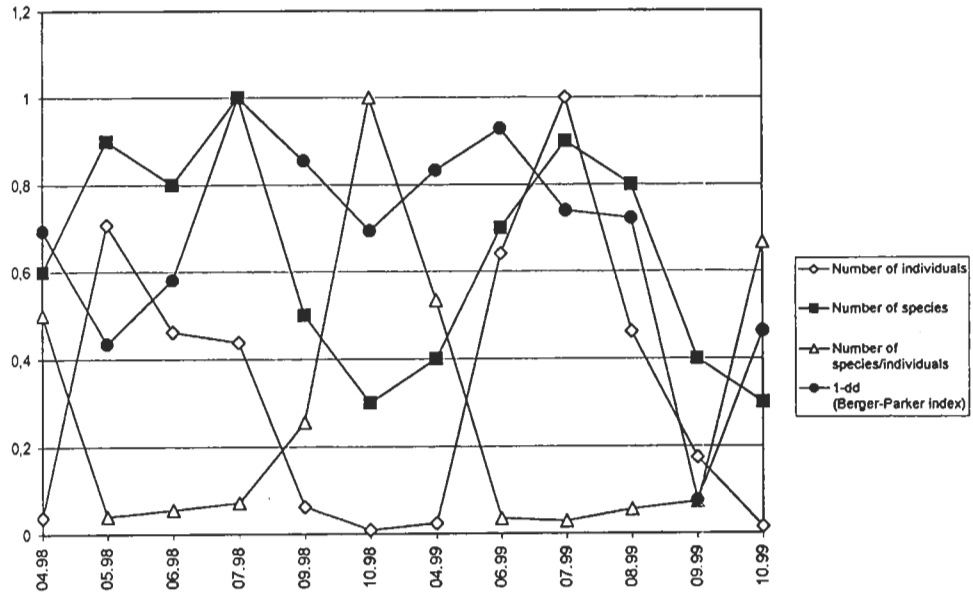


Fig. 3. Seasonal pattern of diversity components. Data have been standardized with their maximum values. (Maximum values for the applied catagories: total number of specimens: 212, species: 10, relative abundance of species: 1.5, Berger-Parker index: 0.72)

Table 2 features a comparison of the above data with earlier studies of Lake Fertő. Based on the survey, presence of 12 Gerromorpha and 18 Nepomorpha (altogether 30) species is confirmed. This number of species is quite significant compared to the fauna of our National Parks or important aquatic biotopes (e.g. Hortobágy National Park: 7 Gerromorpha and 22 Nepomorpha, altogether 29 species; Kiskunsági National Park: 8G/19N, altogether 27 species; Bükk National Park: 11G/21N, altogether 32 species; Duna-Dráva National Park, Barcs: 2G/5N, altogether 7 species; Bátorliget: 7G/12N, altogether 19 species; Balaton: 8G/19N, altogether 27 species; Budapest with 10G/13N, altogether 23 species) (Bakonyi & Vásárhelyi, 1981, 1987, 1993a; Halászfy, 1953; Vásárhelyi & Bakonyi, 1987; Vásárhelyi et al., 1990). From the complete list of species we have calculated the coordinates to represent the similarity pattern of the samples on the basis of their coenotic relations (Fig. 2). The plot shows that Lake Fertő is situated on the edge of the quarter of big lakes, near the axes, which is quite understandable if we consider the shallow nature of the lake and the strong segregation of open water by reeds.

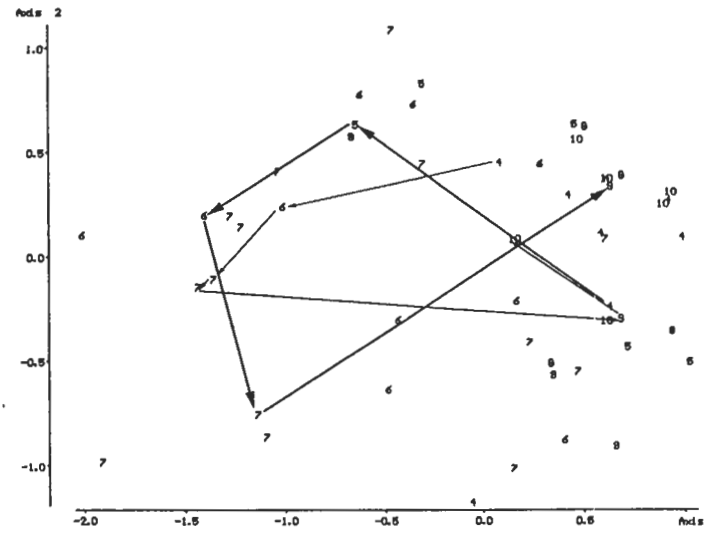


Fig. 4. Ordination plot for sampling occassions of Heteroptera assemblages (Metric Multidimensional Scaling). Numbers stand for months. Locations from Kisherlakni Pond are connected with arrows. → 1998, ➔ 1999

Seasonal dynamics

To make all the months comparable, we used the monthly totals of samples collected from decomposing reed litter *via* the same method. To describe seasonal patterns, we have shown the temporal changes of number of species, total number of individuals, relative abundance of species and the Berger-Parker index (Fig. 3). On the vertical axis, we have shown the values of each data standardized with its maximum in order to be able to show them together. Curves of number of species and number of individuals undoubtedly show the two vegetation periods. As number of individuals grow, number of species gets saturated, thus high values of abundance of species coincide with low values of number of individuals. Seasonality is not shown by the Berger-Parker index. In the course of the two years, diversity components show a similar dynamic pattern. In the spring, when both the number of species and number of individuals are low, the Berger-Parker index and relative abundance of species show a higher value. In the middle of summer (in July), both the number of species and number of individuals are at their peaks, but this state is also characterized by higher uniformity and lower relative species abundance, *i.e.* with growing number of species and individuals dominance of dominant species gets stronger, too. In autumn,

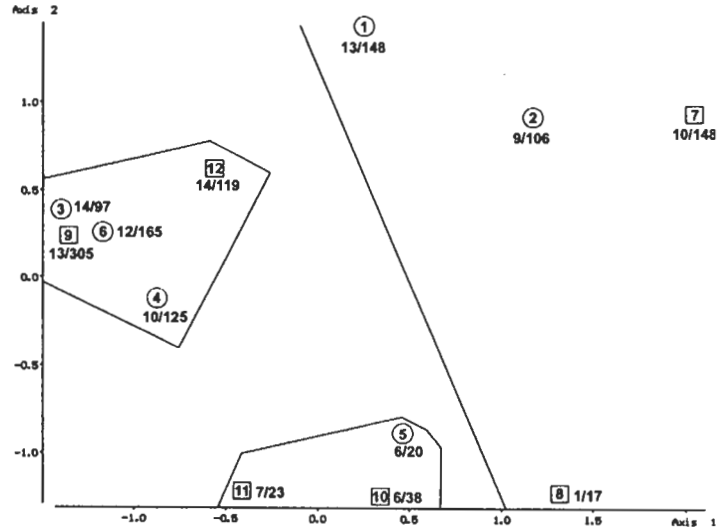


Fig. 5. Ordination plot for sampling locations of Heteroptera assemblages (Metric Multidimensional Scaling). Next to each point stand number of species and individuals, respectively. 1,7: B0 inner; 2,8: B0 outer; 3,9: Kisherlakni Pond; 4,10: Átjáró Pond – reed; 5: Átjáró Pond – rhizome; 6, 11: Nádas 3; 12: Herlakni Pond, O - samples from 1998, □ - samples from 1999

numbers of individuals of the dominant species decrease most heavily, thus lower number of individuals in the autumn coincides with a higher relative abundance of species and lower uniformity. The very same phenomenon can be observed at other macroinvertebrate groups, too. Similarity of the Heteroptera communities of each sampling site over the course of time is shown by an ordination made by principal coordinate analysis (Fig. 4). Samples taken over the summer (in June/July) appear mainly on the left side of the chart, while spring and autumn samples appear mixed on the right side. Therefore it is apparent that differences between sampling sites are primarily due to samples taken in the summer. In the figure we have drawn the temporal trajectory of the Kisherlakni Pond, which shows two loops in parallel with the two years of samples taken.

Similarity pattern of yearly data of sampling sites

Data from samples taken from decomposing reed litter were summarized according to sampling sites and years and the similarity patterns were

analyzed by ordination (Fig. 5). Beside individual data points, we also showed the number of individuals and number of species. Interestingly, samples from site B0 separate well from other sites, which can be explained by the difference of the habitats. Site B0, unlike other sites, is a more open area exposed to the prevailing northern, north-eastern winds, where we can find a couple of cubic metres of reed debris piled up naturally. A difference is also evident considering hydrochemical parameters as pH and lower values for dissolved O_2 concentration are higher than those of other sites, while conductivity is lower. The difference of B0 from other sites is reflected by the macroinvertebrate fauna as well. Two more groups can be identified on the figure: samples from both years from the Kisherlakni Pond are similar to those of Herlakni Pond in 1999 and those of Nádas 3 and Átjáró Pond in 1998. This is separated from the other group (Átjáró Pond rhizome in 1998, Nádas 3 and Átjáró Pond in 1999) because of considerably higher values of the number of individuals and number of species. Interestingly, samples taken in 1998 at Átjáró Pond and Nádas 3 belong to the first group, while the ones taken in 1999 belong to the other. This can be explained by the higher degree of shading throughout 1999, caused by strong proliferation of filamentous algae on the surface of the reed sheaf in the case of Nádas 3, while caused by sinking of the reed sheaf near to the sediment surface in the case of Átjáró Pond. Thus it is not surprising that samples taken from the rhizome show up in this group as degradation of the rhizome is much quicker versus the reed stem, and therefore rhizome pieces originally floating on the water surface sink to the bottom after a couple of months.

Basic patterns of composition and changes of Heteroptera communities are well visible on the basis of studies done between 1995 and 1999, but to explore finer interconnections and causal relations further research is required. Apart from extending the range of study to other macroinvertebrate groups, new results could be obtained by studying other types of habitats and by conducting more detailed hydrochemical investigations.

Acknowledgements. We would like to express our grateful thanks to Prof. Árpád Berczik, Júlia Török and the colleagues of the Fertőrákos Hydrometeorological Station and Fertő-Hanság National Park for helps. This work was supported by the EC-EUREED project (contact number IC-CT96-0020/CT960020 A2).

REFERENCES

1. ANDRIKOVICS, S. (1973): Hidroökológiai és zoológiai vizsgálatok a Fertő hínárosaiban. - Állatt. Közlem., 60: 39-50.

2. ANDRIKOVICS, S. (1978): Series of hydroecological data to the zoological evaluation of the submersed macrophyton stands of Lake Fertő. - Opusc. Zool. Budapest, 15: 23-29.

3. ANDRIKOVICS, S. (1979a): Contribution to the knowledge on the invertebrate macrofauna living in the submersed macrophyton stands of Lake Fertő. - Opusc. Zool. Budapest, 16: 59-65.

4. ANDRIKOVICS, S. (1979b): Fertői makrofauna társulások hidroökológiai viszonyai. - Kandidátusi értekezés, Budapest: 1-157. (Manuscript.)

5. ANDRIKOVICS, S. (1980): Preliminary quantitative macrofaunal investigation on characteristic biotopes of Lake Fertő, Hungary. - Annal. Univ. Sci. Budapest, Sect. Biol., 22-23: 127-144.

6. AUKEMA, B. & RIEGER, C. (1995): Catalogue of the Heteroptera of the Palaearctic Region. - The Netherland Entomol. Soc. Amsterdam, Vol.1 i-xxvi + 1-222.

7. BAKONYI, G. & VÁSÁRHELYI, T. (1981): Contribution to the Heteroptera fauna of the Hortobágy National Park. - In: Mahunka (ed.): The fauna of the Hortobágy National Park. Budapest, 1: 55-63.

8. BAKONYI, G. & VÁSÁRHELYI, T. (1987): The Heteroptera fauna of the Kiskunsági National Park. - In: Mahunka (ed.): The fauna of the Kiskunság National Park. Budapest, 2: 88-90.

9. BAKONYI, G. & VÁSÁRHELYI, T. (1993a): Aquatic and semiaquatic bugs of the Bükk National Park (Heteroptera: Nepomorpha et Gerromorpha). - In: Mahunka (ed.): The fauna of the Bükk National Park. Budapest: 65-67.

10. BAKONYI, G. & VÁSÁRHELYI, T. (1993b): Szakértői tanulmány a Szigetköz akvatikus és szemiakvatikus poloska faunájának vizsgálatáról az 1990-93 években. - Budapest. (Manuscript.)

11. BENEDEK, P. (1969): Poloskák, VII (Heteroptera, VII). - In: Fauna Hungariae, 17: 1-86.

12. CSÖRGITS, G. & HUFNAGEL, L. (2000): Bioindikáció vízi gerinctelenekkel a Dunában. 4. Heteroptera fajegyüttesek hasonlósági mintázata a Dunán. - Hidrol. Közl., 80. (In press.)

13. CSÖRGITS, G. & HUFNAGEL, L. (2000): Heteroptera és Odonata fajegyüttesek a Nyéki-Holt-Duna (DDNP) különböző hínár állományaiban. - Hidrol. Közl. 80. (In press.)

14. DINKA, M. & BERCZIK, Á. (1992): Über die mosaikartigen Unterschiede der „inneren Seen" im Neusiedler See/Fertő. - Opusc. Zool. Budapest, 25: 51-60.

15. GAÁL, M. & HUFNAGEL, L. (1999): Vízi élőhelyek állapotának monitorozása poloska közösségek alapján. - In: Harnos (ed.): Agrárinformatika, 99. Debrecen, Konferencia kiadvány: 346-350.

16. HALÁSZFY, É. (1953): Bátorliget szipókás faunája (Rhynchota). - In: Székessy (ed.): Bátorliget élővilága. Budapest: 395-401.

17. HORVÁTH, G. (1923): A Fertő-tónak és közvetlen környékének Hemiptera-faunája. - Ann. Hist.-nat. Mus. Nat. Hung., 20: 182-199.

18. HUFNAGEL, L. (1998): Data to the knowledge of the aquatic, semiaquatic and shore bug fauna of Budapest and the county Pest (Heteroptera: Nepomorpha, Gerromorpha, Leptopodomorpha). - Folia Entomol. Hung., 59: 29-34.

19. HUFNAGEL, L., GAÁL,. M., FERENCZY, A. & ŐSZI, B. (1999): Többváltozós módszerek alkalmazása rovaregyüttesek tér-időbeli zoocönológiai monitorozásában. - In: Csirik & Herdon (ed.): Informatika a felsőoktatásban 99. (Informatics in the Hungarian Higher Education.) Konferencia kiadvány, Debrecen: 215-220.

20. HUFNAGEL, L., BAKONYI, G. & VÁSÁRHELYI, T. (1999): New approach for habitat characterization based on species list of aquatic and semiaquatic bugs. - Environm. Monitor. Assess., 58: 305-316.

21. HUFNAGEL, L. & VÁSÁRHELYI, T. (2000): On the larvae of Cymatia rogenhoferi (Fieber, 1864) and Gerris asper (Fieber, 1860) (Heteroptera: Nepomorpha, Gerromorpha). - Ann. Hist.-nat. Mus. Nat. Hung., 91: 61-63.

22. HUFNAGEL, L., CSÖRGITS, G. & BÍRÓ, J. (2000): Biodiverzitás mérésének problémái vízirovarok fajegyütteseiben. – Hidrol. Közl. (In press.)

23. HUFNAGEL, L., BAKONYI, G. & VÁSÁRHELYI, T. (2000): Sokváltozós módszerek alkalmazása vízi és vízfelszini poloskákra épülő vízminősítési rendszerekben. – Állatt. Közlem. 83. (In press.)

24. JANSSON, A. (1969): Identification of larval Corixidae (Heteroptera) of Northern Europe. - Ann. Zool. Fenn., 6: 289-312.

25. JANSSON, A (1986): The Corixidae (Heteroptera) of Europe and some adjacent regions. - Acta Entomol. Fenn., 47: 1-94.

26. MOLDOVÁNYI, L. (1977): Adatok a hortobágyi vizek poloska faunájának ismeretéhez (Heteroptera). - Folia Entomol. Hung., 30: 2.

27. MOLDOVÁNYI, L. (1984): Faunisztikai vizsgálatok a Rakaca-tározó poloskáin (Heteroptera). - Folia Entomol. Hung., 45(1): 231-235.

28. PODANI, J. (1993a): SYN-TAX Version 5.0 Users Guide. - Scientia, Budapest: 1-104.

29. PODANI, J. (1993b): SYN-TAX. Computer programs for multivariate data analysis in ecology and systematics. - Abstracta Botanica, 17(1-2): 289-302.

30. PODANI, J. (1997): Bevezetés a többváltozós biológiai adatfeltárás rejtelmeibe. – Scientia, Budapest: 1-412.

31. SAVAGE, A. (1982): Use of water boatmen (Corixidae) in the classification of lakes. - Biol. Conservation, 23: 55-70.

32. SAVAGE, A. (1989): Adults of the British aquatic Hemiptera: key with ecological notes. – Freshwater Biol. Assoc., 50: 1-173.

33. SOÓS, Á. (1963): Poloskák, VIII (Heteroptera, VIII). - In: Fauna Hungariae, 17: 1-48.

34. STUSAK, J. M. (1980): Rád Plostice-Heteroptera. - In: Rozkosky (ed.): Keys to aquatic larvae of insects. Praha: 133-155.

35. SZABÓ, E. (1962): A Fertő-tó vizének kémiai tulajdonságai. - Hidrol. Táj., 1962. dec.: 146-150.

36. VARGA, I. (1997): A fertői avas nád-felhalmozódások Makroinvertebrata együttesei. - Thesis: 1-47. – Budapest. (Manuscript.)

37. VARGA, L. (1962): A Fertő-tó limnológiai sajátosságai. - Hidrol. Táj., 1962. december: 127-129.

38. VARGA, I., ANDRIKOVICS, S. & HUFNAGEL, L. (1998): New data for the macrofauna of Lake Fertő. – Opusc. Zool. Budapest, 31: 143-148.

39. VÁSÁRHELYI, T. & BAKONYI, G. (1987): A Balaton vizén és víztükrén élő poloskák (Heteroptera). - Folia Entomol. Hung., 49: 240-241.

40. VÁSÁRHELYI, T. (1990): Family-key to the larvae of true bugs of Hungary (Heteroptera). - Folia Entomol. Hung., 51: 149-161.

41. VÁSÁRHELYI, T., KONDOROSSY, E. & BAKONYI, G. (1990): The Heteroptera fauna of the Bátorliget Nature Reserves. - In: Mahunka (ed.): The Bátorliget Nature Reserves after fifty years. Budapest: 347-355.

42. VEPSALAINEN, K. & KRAJEWSKI, S. (1986): Identification of the waterstrider (Gerridae) nymphs of the Northern Europe. - Ann. Entomol. Fenn., 52: 63-77.

Revision der Untergattung *Martiodrilus* (*Maipure* Righi, 1995) (Oligochaeta: Glossoscolecidae)

Regenwürmer aus Südamerika, 33

Von

A. Zicsi*

Abstract. „The subgenus *Martiodrilus* (*Maipure* Righi, 1995) (Oligochaeta, Glossocolecidae). Earthworms from South America, 33". *Maipure* Righi, 1995 is regarded as the 4th subgenus of the genus *Martiodrilus* Michaelsen, 1936. On the basis of type materials, the morphological and anatomical characters of the species *M. savanicola, M. agricola, M. micrurus, M. andinus, M. ophioides, M. rigeophilus, M. ohausi, M. huwaldi, M. friderici, M. tenkatei* and *M. palmirus* are revised. A new species, *M. (M.) grandis* sp. n. is described. Keys to the subgenera of *Martiodrilus* as well as to the species of the four subgenera are given.

In vorausgehenden Arbeiten (Zicsi & Csudi, 1997; Zicsi, 1998; Zicsi, 2000) wurde die „Sammelgattung" *Martiodrilus* Michaelsen, 1936 in drei Untergattungen: *M.* (*Martiodrilus* Michaelsen, 1936), *M.* (*Cordilleroscolex* Zicsi & Csuzdi, 1997), *M.* (*Botaria* Zicsi, 1998) getrennt. Alleinstehende Kennzeichen wie rosettenförmiges Nephrostom, verdickte Dissepimente hinter dem Muskelmagen einerseits, das Fehlen von verdickten Dissepimenten hinter dem Muskelmagen sowie die verschiedene Zahl der Samentaschenpaare anderseits wurden zur Begrenzung der Untergattungen herausgegriffen.

In einer der vorausgehend angeführten Arbeiten (Zicsi, 1998, p. 149) wurde erwähnt, dass weitere Arten dieser Sammelgattung abgesondert werden sollen, und zwar diejenigen, die ebenfalls keine verdickten Dissepimente hinter dem Muskelmagen besitzen, aber über 4 Paar Samentaschen verfügen und wo die Chylustaschen von gleicher Form und Struktur in 7 oder 8 Paaren vorhanden sind. In der erwähnten Arbeit wurde weiter vorgeschlagen, dass bis zur Revision der Gattung *Maipure* Righi, 1995, *a priori* sämtliche Arten dieser Gruppe provisorisch als Mitglieder dieser vierten Untergattung von *Martiodrilus* zu betrachten sind.

Das Abtrennen supraspezifischer Taxa hatte bereits bei der Sammelgattung *Thamnodrilus* Beddard, 1891 begonnen, aus der auch die

* *Dr. András Zicsi,* ELTE Állatrendszertani és Ökológiai Tanszék, MTA Zootaxonómiai Kutatócsoport (Lehrstuhl für Tiersystematik und Ökologie der Eötvös-Loránd-Universität, Zootaxonomische Forschungsgruppe der Ungarischen Akademie der Wissenschaften), 1088 Budapest, Puskin u. 3, Ungarn.

Gattung *Martiodrilus* Michaelsen, 1936 hervorgegangen ist. Zuerst wurde die über 8 Paar Chylustaschen und Saumleistenstruktur besitzende Gattung *Inkadrilus* Michaelsen, 1918, dann die über 7 Paar Chylustaschen und Fachkapselstruktur besitzende Gattung *Quimbaya* Michaelsen, 1935 und schliesslich die über 6, 7 oder 8 Paar Kompositenschlauch- bzw. Wabentaschen besitzende Sammelgattung *Martiodrilus* Michaelsen, 1936 abgetrennt. Diese Abtrennungen erfolgten ausschliesslich aufgrund der Chylustaschenstruktur.

Im späteren veranlasste die Anordnung und Zahl der Chylustaschen Righi, die weitere Aufspaltung der inzwischen 50 Arten besitzenden Sammelgattung *Martiodrilus* durchzuführen. So wurden die Gattungen *Zongodrilus* Righi, 1995, mit 8 Paar Chylustaschen im 8.-15. Segment, *Maipure* Righi, 1995, mit 7 Paar Chylustaschen im 8.-14. Segment und *Tupinaki* Righi, 1995 mit 5 Paar Chylustaschen im 7.-11. Segment abgetrennt. Meines Erachtens wird dem Fehlen eines Samentaschenpaares oder einer Verschie-bung dieses Organes nach hinten eine allzu grosse Bedeutung zugemessen, da allein aufgrund dieses Kennzeichens Arten wie *Martiodrilus agricola* (Cognetti, 1904) von *M. ecuadoriensis* (Benham, 1892) und *M. savanicola* (Michaelsen, 1900) in voneinander getrennte Gattungen (z. B. *Maipure*) gestellt werden, obwohl sie in allen anderen Merkmalen vollkommen übereinstimmen. Eben aus diesem Grund halte ich es für zweckmässig, die Gattung *Maipure* einer Revision unterzogen zu werden.

Bei der monophiletischen Gattung *Zongodrilus*, deren Typusart *Z. bolivianus* Righi & Römbke, 1987 anhand weiteren Materials vom gleichen Sammler und Fundort überprüft wurde, konnten Saumleistentaschen bestimmt werden, so dass die Art der Gattung *Inkadrilus* einverleibt wurde. Der Verschiebung dieser Organe um ein Segment oder einer erhöhten Samentaschenzahl wird auch hier keine supraspezifische Bedeutung zugemessen, da in dieser Gattung Arten mit 8 Paar Chylustaschen im 7.-14. oder 8.-15., oder mit 9 Paar im 7.-15. Segment beschrieben wurden (Zicsi, 1995; Zicsi & Csuzdi, 1999).

Von den Righischen Gattungen bleibt allein die Gattung *Tupinaki* mit 5 Paar Chylustaschen als selbständig bestehen.

Untergattung *Martiodrilus* (*Maipure* Righi, 1995) comb. n.

Maipure Righi, 1995: 531.

Maipure als Gattung wurde aufgrund der fehlenden verdickten Dissepimente hinter dem Muskelmagen, der 7 Paar Chylustaschen im 8.-14. bzw. 7.-13. Segment und der aus den Testikelblasen hervorgehenden Samensäcke aufgestellt. Als Typusart wurde *Rhinodrilus ecuadoriensis* Benham, 1892 aus Ekuador, als weitere Arten wurden *Martiodrilus gonggripi* Michaelsen, 1933 aus Surinam, *M. jordani* (Rosa, 1895) aus Paraguay und *M. matapi* Righi, 1969

aus Brasilien angeführt. Durch das Einziehen der Arten *M. savanicola* (Michaelsen, 1900), *M. incertus* (Cognetti, 1906) und *M. ecuadoriensis papillatus* Righi & Römbke, 1987 zu *M. ecuadoriensis* sind Taxa, die ausschliesslich im Andengebiet (Kolumbien, Ekuador und Peru) vorkommen, mit Arten aus dem Amazonasgebiet allein aufgrund der 7 Paar Chylustaschen in eine Gattung gestellt worden, ohne die Zahl der Samentaschenpaare (4, 3 bzw. 2 Paare) zu berücksichtigen. Arten mit 8 Paar Chylustaschen und 4 Samentaschenpaaren sowie ohne verdickte Dissepimente hinter dem Muskelmagen sind dabei nicht berücksichtigt worden, obwohl sich diese nur in den um ein Paar erhöhten Chylustaschen unterscheiden. Besonders auffallend ist dies im Falle von *M. agricola* (Cogneti, 1904), deren Bestimmungsmerkmale bis zum Verwechseln mit *M. savanicola* übereinstimmen und, die nur durch die Zahl der Chylustaschen zu unterscheiden sind. Eine Reduktion der Chylustaschen im 7. Segment lässt sich durch die Verschiebung des Muskelmagens, der aufgrund des Fehlens der verdickten Dissepimente weit nach hinten gerückt ist, erklären. Einer Rückbildung ist in diesem Fall meines Erachtens von geringerem systematischem Belang und nicht ausreichend die Typusart und in diese einverleibte Arten von der Gruppe der Arten mit 8 Chylustaschen und Fehlen von verdickten Dissepimenten hinter dem Muskelmagen zu trennen. Als Typusart wurde *ecuadoriensis* Benham, 1892 designiert. Obwohl ihre Beschreibung auf zahlreichen Fehlern beruht, muss sie auch im weiteren als Typusart der von mir neu gefassten Untergattung *Maipure* beibehalten werden. Die übrigen Arten, die bisher von Righi in diese Gattung eingereiht wurden, müssen im späteren noch anhand der Typen überprüft werden; sie werden nicht in die neugefasste Untergattung *Maipure* gestellt.

Diagnose: Verschieden grosse, rot oder grün pigmentierte Arten. Borsten am ganzen Körper in 8 Längsreihen eng gepaart. Verdickte Dissepimente hinter dem Muskelmagen fehlen. Chylustaschen 7 bzw. 8 Paar im 8.-14. bzw. 7.-14. Segment, gebogene Kompsitenschlauch- bis Wabentaschen mit abgeschnürtem Kopf. Geschlechtsapparat holoandrisch und metagyn. 4 Paar Samentaschen im 6.-9. Segment. Meganephridien ohne rosettenförmiges Nephrostom.

Die Untergattung *Maipure* unterscheidet sich von den übrigen Untergattungen von *Martiodrilus* durch Fehlen der verdickten Dissepimente hinter dem Muskelmagen und der 4 Paar Samentaschen im 6.-9. Segment sowie der einheitlich ausgebildeten Chylustaschen.

Typusart: *Rhinodrilus ecuadoriensis* Benham, 1892 = *Martiodrilus (Maipure) ecuadoriensis* (Benham, 1892).

Zwölf Arten können in die Untergattung eingereiht werden:

M. (*Mp.*) *agricola* (Cognetti, 1904)
M. (Mp.) ecuadoriensis (Benham, 1982)
M. (*Mp.*) *friderici* (Michaelsen, 1918)
M. (*Mp.*) *geayi* (Černosvitov, 1934)

M. (*Mp.*) *grandis* sp. n.
M. (*Mp.*) *micrurus* (Cognetti, 1904)
M. (*Mp.*) *ophioides* (Cognetti, 1904)
M. (*Mp.*) *palmirus* Zicsi & Feijoo, 1991
M. (*Mp.*) *potarensis* (Rosa, 1895)
M. (*Mp.*) *rigeophilus* (Cognetti, 1904)
M. (*Mp.*) *savanicola* (Michaelsen, 1900)
M. (*Mp.*) *tenkatei* (Horst, 1887)

Ausser *M. (Mp.) ecuadoriensis, M. (Mp.) geayi* und *M. (Mp.) potarensis* konnte das Typenmaterial sämtlicher Arten eingesehen werden.

Martiodrilus (Maipure) ecuadoriensis (Benham, 1892)

Martiodrilus (*Maipure*) *ecuadoriensis* (Benham, 1892)
Rhinodrilus ecuadoriensis Benham, 1892:238
Anteus ecuadoriensis, Rosa, 1896:109
Thamnodrilus ecuadoriensis, Michaelsen, 1900:435
Rhinodrilus ecuadoriensis, Cognetti, 1906:17
Rhinodrilus (Aptodrilus) ecuadoriensis, Michaelsen, 1913:241
Thamnodilus (T.) ecuadorienis, Michaelsen, 1918:153
Martiodrilus ecuadoriensis + *M. savanicola* + *M. savanicola incerta*, Righi, 1971:75
Martiodrilus ecuadoriensis + *M. ecuadoriensis papillatus* Righi & Römbke, 1987:526

Die Originalbeschreibung dieser Art, deren Kennzeichen wegen Fehlen der verdickten Dissepimente seinerzeit falsch angegeben sind, wurde zuerst von Rosa, 1896, später von Michaelsen, 1913 revidiert, wobei die mutmassliche Lage dieser Organe angegeben wird. Da in meinem Material weder der Originalbeschreibung noch der revidierten Beschreibung entsprechende Tiere identifiziert werden konnten, kann ich der Art gegenüber nicht Stellung beziehen. Sie wird als Typusart belassen, da sie über 4 Paar Samentaschen, über 7 Paar Chylustaschen (ihre Lage geht aus den Beschreibungen nicht eindeutig hervor, entweder vom 7.-13., oder 8.-14. Segment) verfügt und keine verdickten Dissepimente hinter dem Muskelmagen besitzt.

Martiodrilus (Maipure) savanicola (Michaelsen, 1900)

Anteus savanicola Michaelsen, 1900a:244
Thamnodrilus savanicola, Michaelsen, 1900 b:435
Thamnodrilus savanicola (partim), Cognetti, 1904:5
Rhinodrilus (*Thamnodrilus*) *savanicola*, Cognetti, 1906:178
Rhinodrilus (*Aptodrilus*) *savanicola*, Michaelsen, 1913:241
Thamnodrilus (*Th.*) *savanicola* f. *typica*, Michaelsen, 1918:153
Martiodrilus savanicola savanicola, Righi, 1971:75
Martiodrilus savanicola, Zicsi, 1988:446
Martiodrilus savanicola, Zicsi & Feijoo, 1994:59
Rhinodrilus (*Thamnodrilus*) *incertus* Cognetti, 1906:179 syn. nov.

Fundorte: E k u a d o r . Prov. Carchi. AF/1000 4 Ex., 15 km von Tulcan entfernt, El Carmelo, 16. 5. 1988. leg. Zicsi & Csuzdi. - AF/1010 1 Ex., Rumicacha, 2 km vor der Grenze, 2800 m, 16. 5. 1988. leg. Zicsi & Csuzdi. - AF/3972 3+1 Ex., nach der Abzweigung La Libertad, 3300 m, Paramo-Schwarzerde, 25. 4. 1989. leg. Zicsi & Csuzdi & Lopez. - AF/3897 3 Ex., Chiles Vulkan, oberhalb Tufino, 4300 m, 8. 5. 1990. leg. Zicsi & Csuzdi & Paz. - AF/3912 3 Ex., zwischen Mira und El Angel, 2900 m, 12. 5. 1993. leg. Zicsi & Csuzdi. - AF/3916 1 Ex., zwischen El Angel und Las Juntas, 11 km vor El Angel, 3300 m, 12. 5. 1993. leg. Zicsi & Csuzdi & Florenzio. - Prov. Imbabura. AF/3886 3+2 Ex., San Rafael, 5. 1985. leg. Onore - AF/1972 2 Ex., 56 km von Otavalo in Richtung Selva Alegre, 24. 4. 1989. leg. Zicsi & Loksa & Lopez. - AF/4016 1+1 Ex., 62 km von Otavalo in Richtung Selva Alegre, 1700 m, 24. 4. 1989. leg. Zicsi & Loksa & Lopez. - AF/4038 1 Ex., von Otavalo in Richtung Mojanda Laguna, 3350 m, Paramo-Vegetation, Braunerde, 19. 4. 1989. leg. Zicsi & Loksa & Troya. - Prov. Pichincha. AF/3722 1+1 Ex., Finca Los Cypressos, La Merced, 1. 4. 1987. leg. Zicsi & Loksa & Benavides. - AF/1573 18 Ex., 78 km von Quito in Richtung St. Domingo, 2500 m, 21. 4. 1988. leg. Zicsi & Csuzdi. - AF/1574 5 Ex., 78 km von Quito in Richtung St. Domingo, 1200 m, 21. 4. 1988. leg. Zicsi & Csuzdi. - AF/1583 9+3 Ex., zwischen Quito und St. Domingo, Indianerhütte, 7. 5. 1988. leg. Zicsi & Csuzdi. - AF/1591 3+1 Ex., San Marcos Lagune, Cayambe Vulkan, 4000 m, 6. 5. 1988. leg. Zicsi & Csuzdi. - AF/1607 1+2 Ex., oberhalb der San Marcos Lagune, Cayambe Vulkan, 4200 m, 6. 5. 1988. leg. Zicsi & Csuzdi. - AF/4054 1 pread.Ex., oberhalb Las Palmeras, 2000 m, Regenwald, 17. 4. 1989 leg. Zicsi & Loksa - AF/4108 2 Ex., 5 km hinter St. Rosa, 2400 m, 19. 4. 1990. leg. Zicsi & Csuzdi & Gavilanes. - AF/4112 1+1 Ex., 1 km hinter St. Rosa in Richtung Los Bancos, 2400 m, 19. 4. 1990. leg. Zicsi & Csuzdi & Gavilanes. - AF/4139 2 Ex., hinter St. Rosa, 19. 4. 1990. leg. Zicsi & Csuzdi & Gavilanes. - AF/3705 1+1 Ex., Nanegal-Nanegalito, Res. Maquipucuma, 1300 m, 30. 7. 1996. leg. Mariscal. - Prov. Napo. AF/339 6 Ex., Puerto Misahuali, 250 m, 14. 2. 1986. leg. Zicsi & Loksa. - AF/494 2+3 Ex., 1 km vor Cosanga, 10. 4. 1987. leg. Zicsi & Loksa & Ponce. - AF/3742 4 Ex., Rio Anzu, Piatna, St. Clara, 11. 4. 1987. leg. Zicsi & Loksa & Ponce. - AF/3871 2+1 Ex., hinter Dureno, Regenwald am Ufer des Rio Aquanico, 10. 5. 1988. leg. Zicsi & Csuzdi. - AF/3872 1+2 Ex., oberhalb Baeza, 1500 m, 11. 5. 1988 leg. Zicsi & Csuzdi- AF/4002 1 Ex., zwischen Pifo u. Papallacta 4150 m, 14. 4. 1989. leg. Zicsi & Loksa. - AF/4039 7 pread Ex., Abzweigung St. Barbara, 26. 4. 1989. leg. Zicsi & Loksa & Lopez. - AF/3934 2 Ex., oberhalb San Marcos Lagune, 3820 m, 28. 4. 1990. leg. Zicsi & Csuzdi. - Prov. Cotopaxi. AF/4131 2 Ex., 26 km hinter La Mana, Regenwald, 800 m, 23. 4. 1990. leg. Zicsi & Csuzdi & Gavilanes. - AF/4144 3 Ex., 20 km hinter La Mana, 750 m, 23. 4. 1990. leg. Zicsi & Csuzdi & Gavilanes.

K o l u m b i e n . AF/2307 1 Ex., Hochebene von Bogota, 2600 m, Unterlauf Rio Sapo bei Parque Sapo, 17. 11. 1978. leg. Sturm. - AF/3529 1 Ex., Cordillera Central, Ruiz-St. Isabel Laguna Verde, 4300 m, 9. 10. 1978. leg. Sturm. - AF/3534 1 Ex., Paramo de Simapaz, cca. 3600 m, unter Graminee (Calamogrostis), 4. 10. 1978. leg. Sturm. - AF/2306 1 Ex., Paramo de San Cayetano, Sabaneque, 3400 m, Kartoffelfeld. 5. 9. 1989. leg. Sturm. - AF/3525 2 Ex., Paramo de Chingaza bei Chuza, 3000 m, 28. 9. 1989. leg. Sturm. - AF/2311 1 Ex., Palmira, Tenjo, 2050 m, 23. 4. 1991. leg. Feijoo. - AF/3485 3 Ex., Dept. del Putumayo, Municipio de Sibundoy, 2100 m, Valle de Sibundoy, 13. 1. 1992. leg. Feijoo. - AF/3491 1 Ex., 3494, 4 Ex., Dept. del Cauca, Municipio de Santa Rosa, 5. 1. 1992. leg. Feijoo. - AF/3498 2 Ex., Depto. del Cauca, Municipio de Santa Rosa, Corregimiento La Cristalina, 1180 m, 5. 1. 1992 leg. Feijoo. - AF/3500 1 Ex., Depto. del Cauca, Municipio de Santa Rosa, Corregimiento La Cristalina, 1130 m., 6. 1. 1992. leg. Feijoo. - AF/3667 1 Ex., Municipio de Florida Páramo de Tinajas, 3670 m, Debajo de Frailejón, Depto del Valle, 15. 5. 1992. leg. Feijoo. - AF/3695 2 Ex., Municipio de Mocoa, Estación de La Corporación Autonoma del Putumayo, Depto del Putumayo, 650 m, 9. 1. 1992. leg. Feijoo. - AF/2464 1 Ex., Sendero el Mirador, 2650 m, 17. 4. 1993. leg. Zicsi & Csuzdi & Feijoo. - AF/2482 5 Ex., Finca La Sirena, 18. 4. 1993. leg. Zicsi & Csuzdi & Feijoo. - AF/2488 5 Ex., Paramo de Los Dominguez, 3650 m, 23. 4. 1993. leg. Zicsi & Csuzdi & Feijoo. - AF/2489 1 Ex., Paramo de Los Dominguez, 3650 m, 23. 4. 1993. leg. Zicsi & Csuzdi & Feijoo. - AF/2495 1 Ex., Finca La Sirena, 19. 4. 1993. leg. Zicsi & Csuzdi. - AF/2503 2 pread. Ex., Park de la Salud, Cali, 1240 m, 22. 4. 1993. leg. Zicsi & Csuzdi & Feijoo. - AF/3484 1 Ex., AF/3490 2 juv.

Ex., Dept. del Cauca, Municipio de Puerto Tejada, Vereda de Perico Negro, 980 m, 2. 11. 1993. - leg. Feijoo. - AF/3505 2 Ex., Depto. del Valle, Municipio de Yotoco, Reserva de Yotoco, 1600 m, 3. 2. 1995. leg. Feijoo. - AF/3673 1 Ex., Municipio de Paez, Vereda Escalerete, Páramo de Las Moras, 3200 m, Depto. del Cauca 15. 3. 1995. leg. Feijoo. - AF/3682 4 Ex., Municipio de Caldono, Corregimiento Pueblo Nuevo, Vereda Loma Amarilla, 2750 m, Depto. del Cauca, 14. 3. 1995. leg. Feijoo. - AF/3492 1 Ex., Depto. del Cauca, Paramo de Santo Domingo, Vereda Los Andes, Municipio de Santa Rosa, 2700 m, Pradera de *Pennisetum clandestinum*, 3. 1. 1997. leg. Feijoo. - AF/3493 2 Ex., Depto. del Cauca, Paramo de Santo Domingo, Vereda Los Andes, Municipio de Santa Rosa, 2700 m, Pradera de *Pennisetum clandestinum*, 3. 1. 1997. leg. Feijoo. - AF/3506 1 Ex., Depto. Quinida, Parque de Los Nevados, Municipio de Salento, Valle de Cocora, La Montaña, 5. 1. 1997. leg. Feijoo. - AF/3509 1 Ex., Depto. del Quindio, Parque de Los Nevados, Municipio de Salento, La Montaña, 2870 m, 5. 1. 1997. leg. Feijoo. - AF/3657 1 Ex., Municipio de Darien, Lago Calima, Depto. del Valle, 28. 3. 1997. leg. Feijoo.

Wie in vorausgehenden Arbeiten (Zicsi, 1988; Zicsi & Feijoo, 1994) bekanntgegeben, bin ich dieser Art nur im kolumbianischen Material begegnet und konnte das Typenmaterial in der Sammlung von Hamburg (Inv. Nr. V. 5444, Bogota, leg. Bürger) und weiteres von Bürger gesammeltes Material aus Bogota (Inv. Nr. 7288), aus Sibate Fusaganga (Inv. Nr. 7287) und aus Pacho (Inv. Nr. 7286) bestimmen. Die Tiere der drei letzteren Fundorte wurden irrtümlicherweise zu Arten der Gattung *Andiodrilus* eingereiht, die Fundorte gehören aber mit Sicherheit den typischen Fundorten von *savanicola* an. Da mir seinerzeit das Typenmaterial von *incertus* Cognetti, (1906) nicht zur Verfügung stand, konnte ich zu den von Michaelsen (1913) angesprochenen Vermutungen und auch zur Synonymfrage dieser Art nicht Stellung nehmen. Inzwischen ist es mir gelungen, das Typenmaterial aus dem Vale Rio Peripa (Inv. Nr. OL. 392), El Troja Huace (Inv. Nr. 390), St. José (Inv. Nr. OL. 391), Tulcan (OL. 389) und Ibarra (OL. 388) einzusehen. Eine wichtige Vermutung Michaelsens (1913), dass die Chylustaschen nicht im 7.-13., sondern im 8.-14. Segment liegen müssten, wie dies von ihm bei *savanicola* erkannt wurde, liess sich anhand dert noch vorliegenden und nicht ausgetrockneten (OL 390-392) Typenexemplare ebenfalls bestätigen. Cognetti muss sich tatsächlich verzählt haben, oder hat sich durch die falschen Angaben von Michaelsen (1900a,b) bei *savanicola* verleiten lassen. Ein Vergleich meiner jetzt auch in Ekuador gesammelten Tiere überzeugt mich davon, dass *incertus* nicht als gesondertes Taxon (Unterart, Varietät) von *savanicola* betrachtet werden darf. *M.* (*Mp.*) *savanicola* ist eine weit verbreitete und in ihren Kennzeichen (Grösse, Farbe, Ausdehnung der Gürtel und Pubertätsorgane und Form der Samentaschen) sehr variable Art. Sie ist sowohl in Kolumbien als in den nördlichen Teilen Ekuadors überall in der obersten Bodenschicht anzutreffen.

Da ausführliche Beschreibungen und weitere morphologische Angaben vorliegen (Michaelsen, 1900a, 1913; Cognetti, 1906; Zicsi, 1988; Zicsi & Fejoo, 1994), verzichte ich auf eine Wiederholung dieser.

Martiodrilus (Maipure) agricola (Cognetti, 1904)

Thamnodrilus savanicola (partim) + *Th. agricola* Cognetti, 1904:5
Rhinodrilus (*Thamnodrilus*) *agricola*, Cognetti, 1906:198
Thamnodrilus (*Th.*) *agricola*, Michaelsen, 1918:140
Martiodrilus agricola, Righi, 1971:75
Martiodrilus agricola, Zicsi, 1988:444
Martiodrilus agricola, Zicsi & Feijoo, 1994:61
Martiodrilus agricola Righi, 1995:520

Fundorte: E k u a d o r . Prov. Pichincha. AF/510 4+1 Ex., La Merced, Finca Los Cypressis, Flussufer, 26. 2. 1986. leg. Zicsi & Loksa & Benavides. - AF/1572 18 Ex., zwischen Quito und St. Domingo, 46 km von Quito, 3600 m, 21. 4. 1988. leg. Zicsi & Csuzdi. - AF/1576 3 juv. Ex., 10 km von Quito, neben der Autobahn, 2800 m, 22. 4. 1988. leg. Zicsi & Csuzdi. - AF/1606 6 pread. Ex., 56 km von Quito, in Richtung St. Domingo, 7. 5. 1988. leg. Zicsi & Csuzdi. - AF/1610 2 Ex., Iliniza, 3700 m, 13. 5. 1988. leg. Zicsi & Csuzdi. - AF/1611 6 Ex., hinter El Chaupi in Richtung El Refugio, 65 km von Quito 2500 m, 13. 5. 1988. leg. Zicsi & Csuzdi. - AF/1613 2 Ex., Iliniza, 4100 m, 13. 5. 1988. leg. Zicsi & Csuzdi. - AF/1615 3 pread. Ex., Antisana, 3500 m, 17. 5. 1988. leg. Zicsi & Csuzdi. - AF/1616 3 Ex., Antisana 3500 m, 17. 5. 1988. leg. Zicsi & Csuzdi. - AF/3986 1 Ex., Antisana, 3600 m, Versuchsfeld von Lopez, 15. 4. 1989. leg. Zicsi & Loksa. - AF/3988 8 Ex., Antisana, 3500 m, 15. 4. 1989. leg Zicsi & Loksa. - AF/4043 6 Ex., praead., 2750 m, 10 km von Rio Blanco in Richtung Lloa, 29. 4. 1989. leg. Zicsi & Loksa & De Vries. - AF/4053 1+2 Ex., 16 km von Rio Blanco in Richtung Lloa, 19. 4. 1989. leg. Zicsi & Loksa & De Vries. - Prov. Napo. AF/3858 1+1 Ex., 7 km oberhalb Papallacta, 3300 m, 11. 5. 1988. leg. Zicsi & Csuzdi - AF/3859 2 Ex., oberhalb Papallacta, 3800 m, 11. 5. 1988. leg. Zicsi & Csuzdi. - AF/3876 6 Ex., unterhalb Papallacta, 3100 m, 11. 5. 1988. leg. Zicsi & Csuzdi. - AF/3878 4 Ex., oberhalb Papallacta, 3800 m, 11. 5. 1988. leg. Zicsi & Csuzdi. - AF/3908 1 +1 juv.Ex., zwischen Pifo und Papallacta, 3600 m, 4. 5. 1990. leg. Zicsi & Csuzdi & Paredes. - Prov. Cotopaxi. AF/4032 15 Ex., juv., AF/4051 3 Ex., 63 km von Quito, am Fuss des Cotopaxi Vulkans, El Boticlie, 3500 m, 3. 5. 1989. leg. Loksa & Zicsi. – Prov. Canar. AF/1565 7 Ex., 12 km vor El Tambo, 3100 m, 25. 4. 1988. leg. Zicsi & Csuzdi. – Prov. Tungurahua. AF/3724 1 Ex., Pilahuin, 3100 m, 2. 4. 1987. leg. Zicsi & Loksa. – Prov. Azuay. AF/1564 1 Ex., zwischen Cuenca und Loja, 52 km von Cuenca, 4115 m, 26. 4. 1988. leg Zicsi & Csuzdi.

K o l u m b i e n . AF/2498 8 Ex., Finca Los Andes, 3000 m, Municipio El Cerrito, 23. 4. 1993. leg. Zicsi & Csuzdi.

Interessant ist die Verbreitung von *agricola*, die in Ekuador südlich von *savanicola* am häufigsten anzutreffen war und auch weiter in den Süden des Landes hineinreicht. In Kolumbien wurde sie von uns nur an drei, von Righi (1995) an einem Fundort erwähnt.

Da das Typenmaterial der Cognettischen Art (Quito, Inv. Nr. 423, Papallacta, Inv. Nr. 379) jetzt überprüft werden konnte, liess sich meine Feststellung, dass die Pubertätsstreifen auch das 27. Segment berühren, wie dies bei Tieren vom *Locus typicus* in Papallacta und Quito bereits nachgewiesen werden konnte (Zicsi, 1988), bestätigen. Die weiblichen Poren konnten am hinteren Teil des 14. Segments, die männlichen Poren auf Intersegmentalfurche 20/21 erkannt werden. Ansonsten ist die Originalbeschreibung und die Ergänzungsbeschreibungen von Zicsi (1988) und Righi (1995) so ausführlich, dass auf eine Wiederholung an dieser Stelle verzichtet wird.

Fundorte: Holotypus AF/3413 Prov. Carchi. Chiles Vulkan, oberhalb Tufino, 30 km von der Schranke entfernt, 4200 m, 8.5. 1990. leg. Zicsi & Csuzdi & Paz. - Paratypen AF/3925 2+3 juv. Ex. Fundort wie beim Holotypus. - AF/3902 1 Ex., AF/3424 3 Ex., AF/3947 1 Ex., Fundort wie beim Holotypus, 4300 m. – AF/1015 Südseite des Chiles Vulkans, 4300-4500 m, 15. 5. 1988. leg. Zicsi & Csuzdi.

Von dieser neuen Art liegen mehrere Exemplare in verschiedenen Entwicklungsstadien vor. Nur der Holotypus besitzt eine besonders kräftige Verdickung des Gürtels; er war bei den übrigen Tieren nicht so kräftig ausgebildet, obwohl er auch hier deutlich zu erkennen ist, und die Tiere geschlechtsreif sind. Es ist anzunehmen, dass eine volle Ausbildung sich nur beim Holotypus vollzogen hat.

Äussere Organisation. Länge des Holotypus 182 mm, Breite 10 mm, Segmentzahl 101 (ein Stück des Schwanzes fehlt). Paratypen: Länge 120-200 mm, Breite 7-9,5 mm, Segmentzahl 129-166.

Farbe lebend grün, abgetötet dunkelgrau. Kopf eingezogen, daumenförmig. 1.-2. Segment verwachsen. 2. Segment längsgefurcht. Borsten gepaart, ventrale Borsten vom 4., laterale vom 6. Segment erkannt. Borstenverhältnis hinter dem Gürtel *aa:ab:bc:cd:dd* wie 2:5:4:1,8:12. Borsten *ab* des 9.-12., 15.-16.,18.-19. und 20.-27. Segments von einem kleinen weissen Hof umgeben. Wegen der drüsigen Struktur sind diese beim Holotypus nicht zu erkennen. Borsten dieser Segmente z. T. zu Geschlechtsborsten oder Übergangsborsten zwischen Normal- und Geschlechtsborsten verwandelt. Länge der Geschlechtsborsten 1,2 mm, Breite 0,05 mm, Zahl der Narben 8-10. Länge der Übergangsborsten 1,1 mm, Breite 0,04 mm, Zahl der Narben 6-7. Nephridialporen in der Borstenlinie *cd*. Samentaschenporen auf Intersegmentalfurche 5/6-8/9.

Gürtel sattelförmig vom 14.-1/2 27., 27. Segment, Pubertätstreifen vom 1/2 20.-1/2 27. Segment. Weibliche Poren auf dem 14. Segment in der Borstenlinie *ab*. Männliche Poren auf Intersegmentalfurche 20/21, in Höhe der Pubertätsstreifen (Abb. 1).

Innere Organisation. Verdickte Dissepimente hinter dem Muskelmagen fehlen. Dissepimente von 12/13-18/19 zu erkennen. Stark nach hinten verzogener Muskelmagen im 6. Segment. Schlund mit einem langen Vormagen vor dem Muskelmagen, an den die Peptonephridien angeschmiegt sind. 7 Paar Chylustaschen im 8.-14. Segment, gebogene Wabentaschen mit abgeschnürtem Kopf. Herzen im 7.-11. Segment, die im 12. Segment nur schlingenförmige dünne Gebilde. Herzen im 10. und 11. Segment, stark angeschwollen. Hoden und Samentrichter im 10. und. 11. Segment in hypooesophageale Testikelblasen eingeschlossen, die ventral miteinander in Verbindung stehen. Aus den Testikelblasen beider Seiten gehen nach Durchbrechung der hautdünnen Dissepimente 10/11 und 11/12 die Samensäcke des 11. und 12. Segments hervor. Die des 11. Segments sind nach vorne gerichtet, manchmal auch den Muskelmagen überdeckend, die des 12.

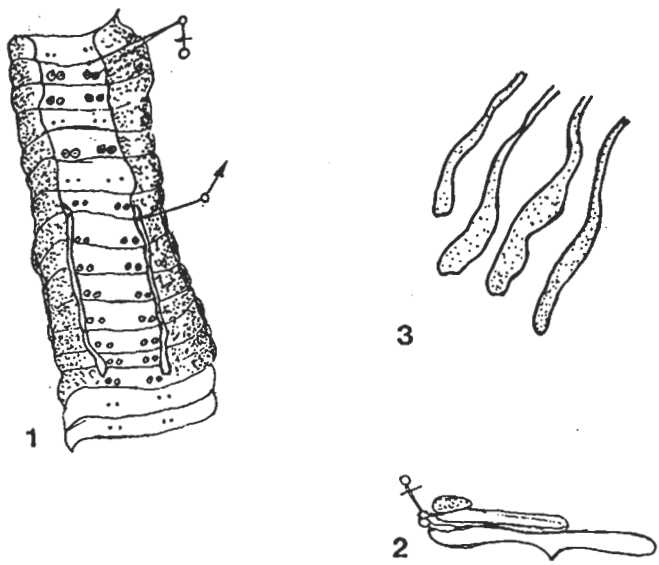


Abb. 1–3. *Martiodrilus (Maipure) grandis* sp. n. 1: Ventralansicht. 2: Nephridium. 3: Form der Samentaschen

Segments sind nach hinten gerichtet und umschlingen den Oesophagus, ohne aber miteinander verwachsen zu sein. Ovarien im 13. Segment, winzige Gebilde, Ovarialblase wird vom 13./14. Dissepiment gebildet. Mitteldarm im 18. Segment, Thyphlosis im 27. Segment beginnend. Nephridien mit Nephridialblase (Abb. 2) ohne rosettenförmiges Nephrostom.

Vier Paar Samentaschen im 6.-9. Segment, keulenförmige Gebilde mit länglichem Ausführungsgang; erstes Paar immer kleiner als die übrigen (Abb. 3).

Die neue Art steht *M.* (*Mp.*) *savanicola* am nächsten, unterscheidet sich von dieser durch die bedeutend grösseren Dimensionen, durch die grüne Farbe und durch die Lage des Gürtels. Von *M.* (*Mp.*) *tenkatei* unterscheidet sie sich durch die Zahl der Chylustaschen und durch die Form der Samensäcke, die nicht aus den Testikelblasen hervorgehen.

Martiodrilus (Maipure) tenkatei (Horst, 1887)

Rhinodrilus tenkatei Horst 1887:101
Anteus tenkatei, Rosa, 1895:110
Thamnodrilus tenkatei, Michaelsen, 1900:435
Rhinodrilus (*Thamnodrilus*) *tenkatei*, Cognetti, 1906:202
Thamnodrilus (*Thamnodrilus*) *tenkatei*, Michaelsen, 1918:144

Die in der Sammlung von Hamburg aus Suriname vorliegenden Exemplare (Inv. Nr. V. 5077) konnten überprüft werden. Schon Rosa (1896) versuchte die vermutliche Lage der Organe, die von Horst falsch angegebn wurden, zu rekonstruieren. Richtig beschrieb Michaelsen (1918) die Art anhand eines Exemplares von Horst und aufgrund zahlreicher geschlechtsreifer Tiere aus Suriname. Als Ergänzung dieser Beschreibungen kann die Lage der männlichen Poren auf dem 21./22. Segment bekanntgegeben werden. Die getrennt verlaufenden Samenrinnen verschwinden im 21. Segment und treten auf Intersegmentalfurche 21/22 aus.

Martiodrilus (Maipure) friderici (Michaelsen, 1918)

Thamnodrilus (*Thamnodrilus*) *friderici* Michaelsen, 1918:141
Martiodrilus ecuadoriensis papillatus Righi & Römbke, 1987:526 syn. nov.
Martiodrilus friderici, Zicsi & Csuzdi, 1999:129

Im vorliegenden Material sind keine Tiere dieser Art angetroffen worden. In einer vorausgehenden Arbeit ist ein Exemplar dieser Art aus Peru, Prov. Loreto, Ökologische Station von Panguana bestimmt worden. Von gleichem Fundort und von gleichem Sammler ist vorausgehend *Martiodrilus ecuadoriensis papillatus* Righi & Römbke mit 7 Paar Chylustaschen beschrieben worden, während diese von uns bei dem einen Exemplar mit 8 Paaren bestimmt wurden. Von Herrn Römbke wurden mir freundlicherweise weitere Exemplare übersandt. Obwohl diese Tiere juvenil waren, konnte der Blinddarm im 26. Segment und auch die 8 Paar Chylustaschen erkannt werden. Es ist kaum anzunehmen, dass das von Righi und Römbke beschriebene Exemplar nur 7 Chylustaschen besass, so dass diese Unterart mit *M. (Maipure) friderici* vereinigt wird.

Martiodrilus (Maipure) palmirus Zicsi & Feijoo, 1994

Martiodrilus palmirus Zicsi & Feijoo, 1994:60

Im vorliegenden Material sind weder aus Kolumbien noch aus Ekuador weitere Tiere angetroffen worden.

Martiodrilus (Maipure) rigeophilus (Cognetti, 1904)

Thamnodrilus rigeophilus Cognetti 1904:13
Rhinodrilus (*Thamnodrilus*) *rigeophilus*, Cognetti, 1906:200
Thamnodrilus (*Thamnodrilus*) *rigeophilus*, Michaelsen, 1918:140

Fundorte: Prov. Chimborazo. AF/3728, 5 Ex., Cerka, Huan de Valesco 3200 m, 4. 4. 1987. leg. Zicsi & Loksa & Coloma. - AF/3881 3+1 juv. Ex., 3971, 1 Ex., Vulkan Chimborazo, 4000 m, 7. 1986 leg. Onore.

In der Sammlung von Torino lagen nur 2 Exemplare aus Paredones, 4042 m (Inv. Nr. 441) vor, die juvenilen Tiere aus Ibarra sind nicht angetroffen worden. Beide Tiere waren geöffnet, bei einem Tier fehlten sämtliche inneren Organe, beim anderen konnte die Form der Testikelblasen sowie die Chylustaschen nicht erkannt werden. Bei einem Tier liegt der Gürtel vom 15.-1/4 26., beim anderen vom 14.-1/4 26. Segment und nicht wie in der Originalbeschreibung vom 15.-25., 26. Segment. Auch die Pubertätsstreifen sind vom 20.- 1/2 26. Segment erkannt worden.

Unsere Tiere weichen etwas in der Form der Samentaschen ab, da der Auführungsgang etwas länger ist als bei den Originalstücken. Die stark drüsige Struktur des Gürtels nimmt das ganze 26. Segment ein, verfärbt ist auch das 14. und 27. Segment, jedoch nicht drüsig.

Martiodrilus (Maipure) micrurus (Cognetti, 1904)

Thamnodrilus micrurus Cognetti, 1904:8
Thamnodrilus micrurus var. Cognetti, 1904:8
Rhinodrilus (*Thamnodrilus*) *micrurus*, Cognetti, 1906:218
Rhinodrilus (*Thamnodrilus*) *andinus* Cognetti, 1906:56 syn. nov.
Thamnodrilus (*Thamnodrilus*) *micrurus*, Michaelsen, 1918:132
Thamnodrilus (*Thamnodrilus*) *ohausi* Michaelsen, 1918:126 syn. nov.
Thamnodrilus (*Thamnodrilus*) *huwaldi* Michaelsen, 1918:133 syn. nov.
Martiodrilus micrurus, Righi, 1995:
Martiodrilus micrurus, Zicsi & Csuzdi, 1999:127

Fundorte: Prov. Cotopaxi. AF/299 3 Ex., Pueblo Quemado, 16. 2. 1986. leg. Zicsi & Loksa. - Prov. Pichincha. AF/1571 1+ 2 juv. Ex., zwischen Quito und St. Domingo, 58 km von Quito entfernt, 3600 m, 24. 4. 1988. leg. Zicsi & Csuzdi. - AF/1577 1 + 3 juv. Ex., zwischen Quito und St. Domingo, 71 km von Quito entfernt, 2500 m, 24. 4. 1988. leg. Zicsi & Csuzdi. - AF/3766 6 Ex., 72 km von Quito in Richtung St. Domingo, 2500 m, 21. 4. 1988. leg. Zicsi & Csuzdi. - AF/3880 2 Ex., hinter El Champi, Iliniza, 4000 m, 13. 5. 1988. leg. Zicsi & Csuzdi. - AF/3850 1 Ex., vor St. Domingo bei der Indianerhütte, 2500 m, 7. 5. 1988. leg. Zicsi & Csuzdi. - Prov. Napo. AF/1580 1 Ex., oberhalb der San Marcus Lagune, Cayambe-Vulkan, 4200 m, 23. 4. 1988. leg. Zicsi & Csuzdi & Székely. - AF/1581 1+1 juv. Ex., Cayambe-Vulkan, oberhalb Ayora, 3000 m, 23. 4. 1988. leg. Zicsi & Csuzdi. - AF/3929 2 Ex., zwischen Pifo und Papallacta, 4200 m, 4. 5. 1990. leg. Zicsi & Csuzdi & Paredes. - AF/3993 6 Ex., zwischen Pifo und Papallacta, 4150 m, 14. 4. 1989. leg. Zicsi & Loksa. - Prov. Tungurahua. AF/1589 2+3 juv. Ex., hinter Riobamba, oberhalb Mocha Pata, 3600 m, 5. 5. 1988. leg. Zicsi & Csuzdi. - Prov. Azuay. AF/1579 9 Ex., 2 km hinter Sigsig, Wiese, 2700 m, 3. 5. 1988. leg. Zicsi & Csuzdi. - AF/1585 4 Ex., zwischen Giron und Victoria de El Portete, Wiese, 2000 m, 2. 5. 1988. leg. Zicsi & Csuzdi. -

AF/1604 4 Ex., 6 km oberhalb Sigsig, 3100 m, 3. 5. 1988. leg. Zicsi & Csuzdi. - AF/3785 1+1 Ex., 16 km von Cuenca, 2500 m, 26. 4. 1988. leg. Zicsi & Csuzdi. - AF/3840 8 Ex., 6 km oberhalb Sigsig, 3100 m, 3. 5. 1988. leg. Zicsi & Csuzdi. - AF/3835 2 Ex., oberhalb Gualaceo, in Richtung Sigsig, 34 km von Cuenca, entfernt, Wiese, 2200 m, 3. 5. 1988. leg. Zicsi & Csuzdi. - AF/3838 15+30 juv. Ex., 2 km hinter Sigsig, Wiese,. 2700 m, 3. 5. 1988. leg. Zicsi & Csuzdi. - Prov. Cañar. AF/3842 1 Ex., hinter Biblian, 36 km von Cuenca entfernt, 2600 m, 4. 5. 1988. leg. Zicsi & Csuzdi. - AF/3843 2 Ex., hinter Biblian, 36 km von Cuenca, Wiese, 2600 m 4. 5. 1988. leg. Zicsi & Csuzdi. - AF/1605 6 Ex., hinter Biblian, 44 km von Cuenca entfernt, 2700 m, 4. 5. 1988. leg. Zicsi & Csuzdi. - Prov. Loja. AF/1562 6+1 Ex., 5 km hinter Saraguro, 2500 m, 26. 4. 1988. leg. Zicsi & Csuzdi. - AF/1566 11 Ex., 46 km von Loja entfernt, in Richtung Cuenca, 2300 m, 30. 4. 1988. leg. Zicsi & Csuzdi. - AF/1567 7 Ex., 47 km von Loja, in Richtung Cuenca, Wiese, 2500 m, 30. 4. 1988. leg. Zicsi & Csuzdi. - AF/1569 9 Ex., Loja, 3 km oberhalb Hacienda el Cortijo, 2200 m, 27. 4. 1988. leg. Zicsi & Csuzdi. - AF/1575 2 Ex., 5 km hinter Loja in Richtung Vilcabamba, 2200 m, 27. 4. 1988. leg. Zicsi & Csuzdi. - AF/1601 1 Ex., 18 km hinter Loja, Wiese, 1. 5. 1988. leg. Zicsi & Csuzdi. - AF/3781 1+9 pread. Ex., 5 km hinter Saraguno, Wiese, 2500 m, 26. 4. 1988. leg. Zicsi & Csuzdi. - AF/3783 1 Ex., 5 km hinter Loja in Richtung Vilcabamba, 2000 m, 27. 4. 1988. leg. Zicsi & Csuzdi.

Die vorausgehend beschriebene Artengruppe besitzt oesophageale bzw. hypooesophageale Testikelblasen im 10. und 11. Segment, die allein die Hoden und Samentrichter einschliessen. Die andere Artengruppe dieser Untergattung, die Taxa *micrurus, andinus, ophioides, ohausi* und *huwaldi,* ist mit perioesophagealen Testikelblasen im 10. und 11. Segment beschrieben worden, die ausserdem noch die Herzen, Chylustaschen der beiden Segmente, im 11. Segment auch die Samensäcke einschliessen. Die Arten dieser Gruppe zeigen in der Lage des Gürtels, der Pubertätsstreifen sowie in der Form der Samensäcke und die der Samentaschen eine so grosse Ähnlichkeit, dass sie mit Sicherheit aufgrund der Beschreibungen nicht von einander unterschieden werden können.

Diesen Schwierigkeiten bin ich auch anhand des vorliegenden, aus verschiedenen Teilen des Landes stammenden, reichen Materials begegnet. Durch die Überprüfung des Typenmaterials und einen Vergleich des eignen, zahlenmässig sehr reichen Materials von den Fundorten des *Locus typicus* und dessen Umgebung, wo zielbewusst an zahlreichen Stellen gesammelt wurde, liess sich den weiter oben angeführten Arten gegenüber Stellung beziehen. Vorausgehend sei erwähnt, dass ausser *micrurus,* alle anderen Arten allein von einem Fundort gemeldet wurden.

M. (*Mp.*) *micrurus* wurde aus der Prov. Azuay bei Cuenca (Inv. Nr. OL. 434) und bei Sigsig (Inv. Nr. OL. 436), aus der Prov. Canar bei Canar (In. Nr. OL. 435) gemeldet. Die in der Originalbeschreibung aus dem Vale del Rio Zamore, aus der orientalen Region angführten Exemplare sind in der Sammlung von Torino nicht vorhanden gewesen, die aus Cuenca, 2580 m, waren ausgetrocknet und konnten nicht nachbestimmt werden. Unter Inv. Nr. OL. 1221 lagen weitere 2 Exemplare vor, die aus Peru (Fundort Hualgayo presso Cajamarca, leg. Huwald 1904, del Museo di Amburgo) stammten und von Cognetti ebenfalls als *Rh. (Th.) micrurus* bestimmt wurden. Es handelt sich um denselben Fundort, von welchem 1918 Michaelsen *Th. (Th.) huwaldi* beschrieb. Es ist anzunehmen, dass Michaelsen Tiere zu Cognetti geschickt hatte, die dieser als *micrurus* beschrieb.

Überprüft wurden die aus Sigsig und Canar stammenden Tiere sowie 2 weitere Exemplare aus Cuenca, welche im Typenmaterial von *M. (Cordillerscolex) validus* (OL. 444 Cuenca, leg. Festa) identifiziert werden konnten (Zicsi & Csuzdi, 1999, p. 127). Schon bei der Bestimmung dieser Tiere, die die Nachbestimmung der ausgetrockneten Tiere aus Cuenca nicht ermöglichten, wurde darauf hingewiesen, dass beide Exemplare nicht vollkommen adult waren, d.h. der Gürtel war angedeutet, aber nicht drüsig verdickt, wie dies jetzt an den von allen drei Fundorten gesammelten, eignen Tieren erkannt werden konnte.

Die Überprüfung des Typenmaterials von *andinus, ohausi* und *huwaldi* sowie ein Vergleich mit den eigenen Tieren zeigte, dasss diese Arten nicht weiter aufrechterhalten bleiben können und so zu *micrurus* eingezogen werden. Bei *huwaldi* war selbst Cognetti dieser Meinung, da er die Tiere aus dem Typenmaterial als *micrurus* bestimmte. Eine Überprüfung des Typenmaterials aus der Sammlung des Zoologischen Instituts und Museums von Hamburg (Inv. Nr. V. 6415) brachte mich zu gleicher Überzeugung. Die beiden Exemplare von *Th. (Th.) ohausi* (Inv. Nr. 698O), die in der Umgebung von Loja gesammelt wurden und denen die inneren Organe fehlten, zeigen aufgrund der äusseren Kennzeichen, Lage des Gürtels und der Pubertätsstreifen keine Unterschiede, bei diesen Tieren ist der Gürtel ebenfalls nicht drüsig angeschwollen, wie dies bei Tieren aus meinem Material der Fall ist. Selbst Michaelsen (1918, p. 130) meint in der Originalbeschreibung, dass *ohausi* sich von *micrurus* und *andinus* nur geringfügig unterscheidet. Die Überprüfung der Exemplare von *Rh. (Th.) andinus* aus Paredones (Inv. Nr. 380) lassen ebenfalls keine wesentlichen Unterschiede von *micrurus* erkennen, so dass beide Arten ebenfalls nicht getrennt von *micrurus* weitergeführt werden können.

Als ausschlaggebend betrachte ich die Cognettische Beschreibung von *micrurus* (1906, p. 218), ergänze sie aber mit folgenden Kennzeichen.

Äussere Organisation. Farbe lebend grün, diese geht konserviert verloren, es bleibt nur dorsal eine dunkle Verfärbung übrig. Gürtel sattelförnig, bei den meisten Exemplaren vom 15.-1/2 26, 2/3-26., 26. Segment. Wenn der Gürtel stark drüsig angeschwollen ist, erstreckt er sich auch auf das 14. Segment und nimmt das ganze 26. Segment ein. Pubertätsstreifen sind bei den ganz geschlechtsreifen Tieren deutliche breite Streifen und erstrecken sich vom 20. 1/2 20.-1/2 26., 26. Segment. Weibliche Poren auf dem hinteren Rand des 14. Segments in der Borstenlinie *ab*. Männliche Poren auf Intersegmentalfurche 20/21, in Höhe der Pubertätsstreifen. Borsten *ab* des 8.-10., 16., 18.-19. und die der Gürtelorgane vom 20.-26. Segment von mehr oder weniger deutlichen runden Höfen umgeben; Borsten sind zu Geschlechtsborsten verwandelt. Die Kerben der Borsten variieren je nach Grösse der Borsten zwischen 8 und 12.

Innere Organisation. Verdickte Dissepimente fehlen, hautdünne Verdickungen können vom 8/9 Dissepiment erkannt werden, die nach hinten bis zum 15./16. deutlicher werden. Muskelmagen weit nach hinten verschoben, diesem geht ein Vormagen hinter dem Schlund voraus, dem die

Peptonephridien angeschmiegt sind. Herzen im 7.-12. Segment, die letzteren sind nur dünne schlingenförmige Gebilde. Perioesophageale Testikelblasen schliessen die Hoden und Samentrichter sowie die Herzen und Chylustaschen des 10. und 11. Segments ein, im 11. Segment auch die Samensäcke. Mitteldarm vom 17., Typhlosis vom 27. Segment vorhanden. Nephridien vom 17. Segment mit Nephridialblasen versehen, rosettenförmiges Nephrostom fehlt.

Vier Paar Samentaschen im 6.-9. Segment, die ersten Paare immer kleiner als die übrigen, schlauchförmige Gebilde, die mehr oder weniger länglich bis rund sein können; Ausführungsgang meistens geknickt, an der Basis angeschwollen, in diesen sind manchmal auch Samenklumpen vorhanden.

Martiodrilus (Maipure) ophioides (Cognetti, 1904)

Thamnodrilus ophioides Cognetti, 1904:6
Rhinodrilus (*Thamnodrilus*) *ophioides*, Cognetti, 1906:
Thamnodrilus (*Thamnodrilus*) *ophioides*, Michaelsen, 1918:131

Fundort: Prov. Pastaza. AF/3882 1 Ex., Puyo, 7. 1986. leg. Onore. - AF/4045 2 Ex., 22 km von Pujo in Richtung Bannos, 1100 m, im Moos einer Felswand, 3. 5. 1989. leg. Zicsi &. Loksa.

Von dieser Art konnte nur das eine Exemplar aus Sigsig (Inv. Nr. Ol. 440) überprüft werden, welches die in der Originalbeschreibung angeführten Verdickungen in der Samentaschenregion nicht aufweist. Die besonderen Ausbildungen in der Samentaschenregion müssen von den Exemplaren aus dem Vale del Rio Santiago beschrieben worden sein, und auch Michaelsen (1918) muss von diesen Tieren eines überprüft haben. Bei meinen Exemplaren, die ebenfalls in der orientalen Region gesammelt wurden (AF/4045), sind es bei einem Exemplar nur Drüsenverdickungen im 6. und 7. Segment, beim anderen Exemplar (AF/3382) sind es runde Anhänge, durch die die Samentaschen ausmünden. Ob diese als ausstülpbare Kopulationsapparate zu betrachten sind (Michaelsen, 1918, p. 138), kann ich anhand meines Exemplares nicht unterstützen, aber mit Sicherheit auch nicht anzweifeln, nie bin ich einer solchen Ausbildung von Samentaschen begegnet. Mit Sicherheit unterscheiden sie sich vollkommen von den Samentaschen der Art *micrurus,* so dass *M. (Mp.) ophioides* auch weiter als selbständige Art geführt werden muss, obwohl das einzige Exemplar aus Sigsig, welches in stark erweichtem Zustand vorliegt, eher *micrurus* nahe steht.

Mit der Besprechung der Untergattung *Maipure* ist nun die Revision der Untergattungen der Gattung *Martiodrilus* beendet worden. Es sind insgesammt 72 Arten revidiert oder neu beschrieben worden. Nachstehend wird einersets der Bestimmungschlüssel der Untergattungen, anderseits der Schlüssel der Arten angeführt.

1 Verdickte Dissepimente hinter dem Muskelmagen vorhanden 2
Verdickte Dissepimente hinter dem Muskelmagen fehlen 3

2 Rosettenförmiges Nephrostom fehlt ..... *M.* (*Martiodrilus* Michaelsen, 1936)
Rosettenförmiges Nephrostom vorhanden ..... *M.* (*Cordilleroscolex* Zicsi & Csuzdi, 1997)

3 Zwei oder drei Paar Samentaschen vorhanden ..... *M.* (*Botaria* Zicsi, 1998)
Vier Paar Samentschen vorhanden ..... *M.* (*Maipure* Righi, 1995) comb. nov.

Bestimmungsschlüssel der Arten der Untergattung M. (Martiodrilus Michaelsen, 1936)

1 Blinddarm vorhanden ..... *menai* Zicsi & Csuzdi, 1999
Blinddarm fehlt 2

2 Zwei Paar Samentaschen vorhanden 3
Drei Paar Samentaschen vorhanden 6

3 Oesophageale Testikelblasen vorhanden ..... *devriesi* Zicsi, 1990
Perioesophageale Testikelblasen vorhanden 4

4 Pubertätsstreifen vom 20.-24. Segment ..... *piskakao* Righi, 1995
Pubertätsstreifen vom 20.-23. Segment 5

5 Samentaschen verdoppelt ..... *robustus chilesensis* Zicsi, 2000
Samentaschen nicht verdoppelt ..... *robustus* Zicsi, 2000

6 Oesophageale Testikelblasen vorhanden 7
Perioesophageale Testikelblasen vorhanden 15

7 Pubertätsstreifen bis ins 27. bzw. über das 27. Segment reichend 8
Pubertätsstreifen enden vor dem 27. Segment 9

8 Pubertässtreifen bis ins 27. Segment reichend ..... *interandinus* Zicsi, 2000
Pubertätsstreifen reichen über das 27. Segment ..... *kuehnelti* Zicsi, 1990

9 Herzen bis ins 12. Segment reichend 10
Herzen bis ins 11. Segment reichend 11

10 Pubertätsstreifen vom 20.-24. Segment ..... *heterostichon colpochaeta* (Cognetti, 1906)
Pubertätsstreifen vom 21.-25. Segment ..... *agilis* (Cognetti, 1904)

11 Männliche Poren auf Intersegmentalfurche 20/21 12
Männliche Poren auf Intersegmentalfurche 21/22 14

12 Gürtel vom 15.-1/2 24. Segment ..... *monticola* (Michaelsen, 1900)
Gürtel vom 15.-24. Segment ..... *purnio* (Michaelsen, 1900)
Gürtel vom 15.- 25., 1/2 26., 26. Segment 13

13 Pubertätsstreifen vom 1/2 19.- 24. Segment ..... *heterostichon* (Schmarda, 1861)
Pubertätsstreifen vom 20.-24. Segment ..... *lojaensis* (Michaelsen, 1918)

14 Samentaschenampulle löffelförmig mit langem Ausführungsgang 14
Samentaschenampulle tropfenförmig mit kurzem Ausführungsgang .....
michaelseni Zicsi, 1990

15 Herzen bis ins 11. Segment reichend 16
Herzen bis 12. Segment reichend 20

16 Männliche Poren auf Intersegmentalfurche 20/21 ..... *szekelyi* Zicsi, 2000
Männliche Poren auf Intersegmentalfurche 21/22 17

17 Samentaschen mit Samenkämmerchen ..... *papillatus* Zicsi, 2000
Samentaschen ohne Samenkämmerchen 18

18 Samentaschenampulle löffelförmig verdickt 19
Samentaschenampulle nicht löffelfömig verdickt ..... *nonniorum* Zicsi, 2000

19 Gürtel vom 15.-25. Segment ..... *loksai* Zicsi, 2000
Gürtel vom 15.-26. Segment ..... *cayambensis* Zicsi, 2000
Gürtel vom 1/2 15.-1/2 27. Segment ..... *cosanganensis* Zicsi, 2000

20 Gürtel hinter dem 15. Segment beginnend 21
Gürtel vor dem 15. Segment beginnend 22

21 Zerfallene Borstenreihen am Körperende ..... *pseudotuberculatus* Zicsi, 2000
Borstenreihen am Körperende nicht zerfallen ..... *tuberculatus* (Cognetti, 1904)

22 Samentaschen von Drüsenpölstern umgeben ..... *nemoraloides* Zicsi, 2000
Samentaschen ohne Drüsenpölster 23

23 Pubertätsstreifen des 20., 22. und 24 Segments auf Höckern .....
acanthinurus heterophyma (Cognetti, 1904)
Pubertätsstreifen ohne Höcker 24

24 Samentaschenampulle tropfenförmig ..... *nemoralis* (Cognetti, 1904
Samentaschenampulle löffelförmig ..... *acanthinurus* (Cognetti, 1904)

Bestimmungsschlüssel der Arten der Untergattung M. (Cordilleroscolex Zicsi & Csuzdi, 1997)

1 Samentaschen lang, fadenförmig 2
Samentaschen kurz, tropfenförmig 6
Samentaschen in der Muskelwand verborgen 11

2 Drei Paar Samentaschen vorhanden 3
Vier Paar Samentaschen vorhanden 5

3 Oesophageale Testikelblasen vorhanden 4
Perioesophageale Testikelblasen vorhanden ..... *hamifer* (Michaelsen, 1900)

4 Pubertätsstreifen vom 20.-25. Segment ..... *iserni* (Rosa, 1895)
Pubertätsstreifen vom 20.-1/2 28. Segment ..... *gonzanamanensis* Zicsi & Csuzdi, 1997

5 Oesophageale Testikelblasen vorhanden ..... *iserniformis* Zicsi & Csuzdi, 1997
Perioesophageale Testikelblasen vorhanden ..... *riveti* (Michaelsen, 1910)

6 Oesophageale Testikelblasen vorhanden 7
Perioesophageale Testikelblasen vorhanden 8

7 Gürtel vom 15.-27. Segment ..... *validus* (Cognetti, 1904)
Gürtel vom 14.-28. Segment ..... *bolivianus* Zicsi & Csuzdi, 1999

8 Drei Paar Samentaschen vorhanden 9
Vier Paar Samentaschen vorhanden ..... *pebasiensis* (Cognetti, 1914)

9 Pubertätsstreifen vom 20.-27. Segment ..... *darienianus* (Cognetti, 1905)
Pubertätsstreifen vom 20.-26. Segment 10

10 Männliche Poren auf Intersegmentalfurche 20/21 ..... *columbianus* (Michaelsen, 1900)
Männliche Poren auf Intersegmentalfurche 21/22 ..... *magnus* (Cognetti, 1904)

11 Oesophageale Testikelblasen vorhanden 12
Perioesophageale Testikelblasen vorhanden 13

12 Gürtel vom 15.-26. Segment ..... *crassus* (Rosa, 1895)
Gürtel vom 1/2 14.-1/2 29. Segment ..... *ischuros* Zicsi, 1990

13 Pubertätsstreifen vom 15.-26. Segment ..... *cognettii* (Beddard, 1921)
Pubertätsstreifen vom 20.-28. Segment ..... *beddardi* (Cognetti, 1904)
Pubertätsstreifen vom 21.-28. Segment ..... *tigrinus* Zicsi & Csuzdi, 1997

Bestimmungsschlüssel der Arten der Untergattung M. (Botaria Zicsi, 1998)

1 Blinddarm vorhanden 2
Blinddarm fehlt 4

2 Perioesophageale Testikelblasen vorhanden ..... *pano* Righi, 1992
Oesophageale Testikelblasen vorhanden 3

3 Pubertätsstreifen vom 19.-23. Segment ..... *murindo* Righi, 1995
Pubertätsstreifen vom 21.-25. Segment ..... *vassae* Zicsi & Csuzdi, 1999
Pubertätsstreifen vom 20.-27. Segment ..... *colomai* Zicsi, 1988

4 Perioesophageale Testikelblasen vorhanden 5
Oesophageale Testikelblasen vorhanden 6

5 Gürtel vom 20.-24. Segment ..... *poncei* Zicsi, 1988
Gürtel vom 20.-25. Segment ..... *benhami* (Cognetti, 1904)

6 Männliche Poren auf Intersegmentalfurche 19/20 7
Männliche Poren auf Intersegmentalfurche 20/21 10

7 Pubertätsstreifen vom 19.-22. Segment ..... *minoriformis* Zicsi, 1998
Pubertätsstreifen vom 1/2 19.-1/2 22. Segment ..... *minor* Zicsi, 1998
Pubertätsstreifen vom 1/2 19.-23. Segment ..... *parvus* Zicsi, 1998
Pubertätsstreifen vom 19.-23. Segment ..... *gara* Righi, 1995
Pubertätsstreifen vom 1/2 19.-1/2 26. Segment ..... *feijooi* Zicsi, 1998
Pubertätsstreifen vom 1/2 19.,19.-1/2 24., 24. Segment 8

8 Samentaschen mit Samenkämmerchen ..... *bicolor* (Michaelsen, 1913)
Samentaschen ohne Samenkämmerchen 9

9 Samentaschen kolbenförmig ..... *euzonus filiformis* Zicsi, 1998
Samentaschen schlauchförmig ..... *euzonus* (Cognetti, 1904)

10 Gürtel vom 14.-25. Segment ..... *andiorrhinoides* (Michaelsen, 1918)
Gürtel vom 15.-24. Segment ..... *onorei* Zicsi, 1988
Gürtel vom 15.-25. Segment ..... *tutus* (Cognetti,1904)
Gürtel vom 15.-26. Segment ..... *gravis* (Cognetti, 1904)
Gürtel vom 16.-27. Segment ..... *helleri* (Michaelsen, 1918)

1 Blinddarm vorhanden ..... *friderici* (Michaelsen, 1918)
Blinddarm fehlt 2

2 Sieben Paar Chylustaschen vorhanden 3
Acht Paar Chylustaschen vorhanden 5

3 Pubertätsstreifen hinter den Gürtel reichend ..... *savanicola* (Michaelsen, 1900)
Pubertätsstreifen auf die Gürtelorgane beschränkt 4

4 Gürtel bis ins 25. Segment reichend ..... *palmirus* Zicsi & Feijoo, 1991
Gürtel bis ins 26. Segment reichend ..... *ecuadoriensis* (Benham, 1892)
Gürtel bis ins 27. Segment reichend ..... *grandis* sp.n.

5 Perioesoghageale Testikelblasen vorhanden 6
Oessophageale Testikelblasen vorhanden 7

6 Samentaschen mit Kopulationsapparat ..... *ophioides* (Cognetti, 1904)
Samentaschen ohne Kopulationsapparat ..... *micrurus* (Cognetti, 1904)

7 Pubertätsstreifen hinter den Gürtel reichend ..... *agricola* (Cognetti, 1904)
Pubertätsstreifen auf die Gürtelorgane beschränkt 8

8 Gürtel vom 15.-26. Segment ..... *rigeophilus* (Cognetti, 1904)
Gürtel bis zum 27. Segment reichend 9

9 Gürtel vom 16.-27. Segment 10
Gürtel vom 17.-27. Segment ..... *potarensis* (Rosa, 1895)

10 Pubertätsstreifen vom 21.-27. Segment ..... *tenkatei* (Horst, 1887)
Pubertätsstreifen vom 17.-27. Segment ..... *geayi* (Černosvitov, 1934)

Danksagung. Für die Überlassung von Typenmatrial spreche ich Frau Doz. Dr. H. Ruhberg und Herrn Dr. M. Dzwillo (Zoologisches Institut und Museum der Universität Hamburg) sowie Herrn Dr. A. Rolando (Museo ed Istituto di Zoologia Sistematica della Università, Torino) auch an dieser Stelle meinen besten Dank aus.

SCHRIFTTUM

1. BEDDARD, F. E. (1891): The classification and distribution of earthworms. - Proc. R. Phys. Soc. Edinburg, 10: 235-290, pls. 13-14.
2. BENHAM, W. B. (1892): An earthworm from Ecuador (Rhinodrilus ecuadoriensis). - Ann. Mag. nat. Hist., (6) 9: 237-246, pl. 10.
3. ČERNOSVITOV, L. (1934): Les Oligochètes de la Guyane Française et d'autres pays de l'Amerique du Sud. - Bull. Mus. Nat. Hist. nat. Paris, (2) 6: 47-59.
4. COGNETTI DE MARTIIS, L. (1904): Oligocheti dell'Ecuador. - Boll. Mus. Torino, 19(474): 1-18.
5. COGNETTI DE MARTIIS, L. (1906): Gli Oligocheti della Regione Neotropicale. - II. Mem. R. Accad. Sc. Torino, (2) 56: 147-262, 2 pls.
6. HORST, R. (1887): Description of earthworms. - Not. Leyden Mus., 9: 97-106, 1 pl.
7. MICHAELSEN, W. (1900a): Terricolen-Fauna Colombiens. - Arch. Naturg., 66: 231-266.
8. MICHAELSEN, W. (1900b): Oligochaeta. Das Tierreich 10. - R. Friedländer und Sohn, Berlin, xxix+575 pp.

9. MICHAELSEN, W. (1910): Sur quelques Oligochètes de l'Équateur. - Miss. Arc Meridien Équat. Amér. Sud, (1899-1906) 9, Zool. 3C: 127-138.

10. MICHAELSEN, W. (1910): Oligochäten von verschiedenen Gebieten. - Mitt. Naturhist. Mus. Hamburg, 27: 45-169, 1 pl.

11. MICHAELSEN, W. (1913): Die Oligochaeten Columbias. - In: O. Fuhrmann. & E. Mayor, Voyage d'exploration scientifique en Colombie. Mém. Soc. neuchât. Sc. nat., 5: 202-252, pl. 8.

12. MICHAELSEN, W. (1918): Die Lumbriciden, mit besonderer Berücksichtigung der bisher als Familie Glossoscolecidae zusammengefassten Unterfamilien. - Zool. Jb. Syst., 41: 1-398, pls. 1-2.

13. MICHAELSEN, W. (1933): Die Oligochätenfauna von Suriname. - Tijdsch. Nederl. Dierk. Vereen., (3) 3:112-131, pls. 2-3.

14. MICHAELSEN, W. (1935): Oligochaeten aus Peru. - Capita Zool., 6(2): 1-12.

15. MICHAELSEN, W. (1936): On the genus Thamnodrilus Beddard. - Proc. Zool. Soc. London, 1936: 1171-1173.

16. RIGHI, G. (1969): Sur une espèce aberrante de Glossoscolecidae, Thamnodrilus matapi sp. n. – Pedobiologia, 9: 42-45.

17. RIGHI, G. (1971): Sobre a família Glossoscolecidae (Oligochaeta) no Brasil. - Arq. Zool. S. Paulo, 20(1): 1-96.

18. RIGHI, G. (1981): Alguns Oligochaeta cavernícolas do Equador. - Papéis Avulsos Zool., S. Paulo, 34(22): 235-249.

19. RIGHI, G. (1995): Colombian earthworms. - In: Studies on tropical Andean ecosystems. J. Cramer, Berlin, 4: 485-607.

20. RIGHI, G. & RÖMBKE, J. (1987): Alguns Oligochaeta da Bolívia e do Peru. - Rev. Brasil. Biol., 47: 523-533.

21. ROSA, D. (1895): Viaggio del Doctor Alfredo Borelli nella Repubblica Argentina e nel Paraguay. - XV. Oligochaeti Terricoli. Boll. Mus. Torino, 10(204): 1-3.

22. ROSA, D. (1896): Contributo allo studio dei Terricoli Neotropicali. - Mem. R. Accad. Sc. Torino, (2) 45: 89-151, 1 pl.

23. ZICSI, A. (1988): Weitere neue und bekannte Martiodrilus-Arten aus Ekuador und Kolumbien (Oligochaeta: Glossoscolecidae). Regenwürmer aus Südamerika, 7. - Acta Zool. Hung., 34: 435-446.

24. ZICSI, A. (1998): Revision weiterer Martiodrilus-Arten (Oligochaeta: Glossoscolecidae). Regenwürmer aus Südamerika, 30. - Opusc. Zool. Budapest, 31: 149–164.

25. ZICSI, A. (2000): Die Untergattung Martiodrilus (Martiodrilus Michaelsen, 1936) (Oligochaeta: Glossoscolecidae). Regenwürmer aus Südamerika, 29. – Opusc Zool. Budapest, 32: 139–167.

26. ZICSI, A. & CSUZDI, CS. (1987): Über weitere Riesenregenwürmer aus Ekuador. Regenwürmer aus Südamerika, 28. - Ber. Nat.-med. Verein, Innsbruck, 84: 81-103.

27. ZICSI, A. & CSUZDI, CS. (1999): Neue und bekannte Regenwürmer aus verschiedenen Teilen Südamerikas. Regenwürmer aus Südamerika, 26. - Senckenbergiana Biologica, 78 (1/2): 123-134.

28. ZICSI, A. & FEIJOO, A. (1994): Regenwürmer aus der Zentralkordillere Kolumbiens (Oligochaeta: Glossoscolecidae). Regenwürmer aus Südamerika, 21. - Mitt. Hamb. Zool. Mus. Inst., 89: 55-62.

Opusc. Zool. Budapest, XXXIII, 2001

Communicatio Brevis

On two uncommon structures in nematodes

By

I. ANDRÁSSY*

Abstract. To the single known toothless genus of mononchid nematodes (*Nullonchus*, family Anatonchidae) another unarmed genus/species belonging to the family Mononchidae is added. Since only immature animals were found, neither generic nor specific names are proposed.

The small postcardial organ, *organellum ovale*, recently described in an *Onchulus* species and characterized by an unusually large dorsal pore, was observed in *Prismatolaimus dolichurus*.

1. A toothless genus in the family Mononchidae

Members of the superfamily Mononchoidea are generally known as having spacious, strongly sclerotized buccal cavity armed with larger or smaller teeth. At least one large tooth on the dorsal wall of stoma is present. Among the forty known genera of mononchid nematodes, there is an only exception. Siddiqi described a genus from South America, *Nullonchus* Siddiqi, 1984, that lacks any teeth or denticles in the stoma. In having a roomy buccal capsule and a tuberculate type of oesophago-intestinal junction, *Nullonchus* belongs to the family Anatonchidae. Siddiqi described three species each collected in Colombia.

In a soil sample collected also in South America (Chile), I found some specimens of a remarkable mononchid genus of completely unarmed stoma. These specimens clearly distinguish from *Nullonchus*. Unfortunately, all the five animals are juveniles, second-, third- and fourth-stage larvae, therefore, although the genus and species undoubtedly are new to science, I deem it unadvisable to provide them with scientific names. Each immature animal shows the same shape and structure of buccal cavity. This interesting nematode shall be shortly described below, mainly on the basis of a half-mature L4 larva.

*Dr. *István Andrássy*, ELTE Állatrendszertani és Ökológiai Tanszék, MTA Zootaxonómiai Kutatócsoport (Department of Systematic Zoology and Ecology of the Eötvös Loránd University, Zootaxonomy Research Group of the Hungarian Academy of Sciences), 1088 Budapest, Puskin u. 3, Hungary.

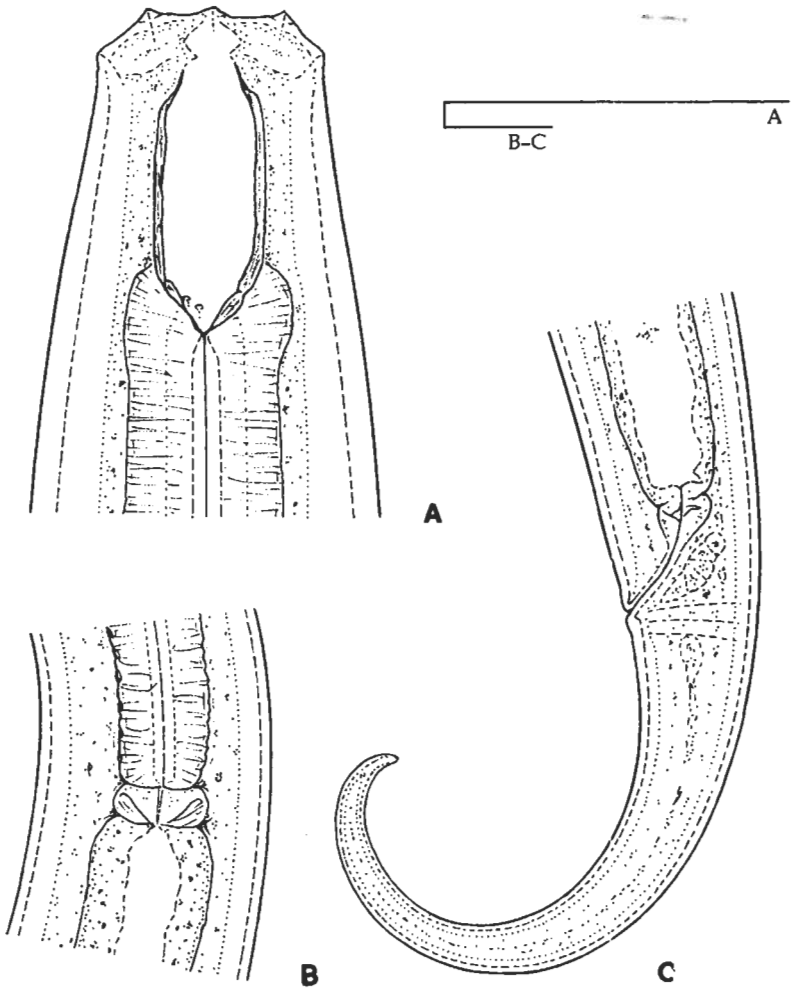


Fig. 1. A semi-adult specimen of a toothless species of Mononchidae from Chile. A: anterior end; B: cardial region; C: tail. (Scale bars 50 µm each)

Fourth-stage larva (L4): L = 3.50 mm; a = 32; b = 5.5; c = 11; c' = 45.

Large nematode, body 110 µm wide on the mid-region. Cuticle smooth, rather thin, 3–4 µm. Head 32 µm wide; body at posterior end of oesophagus 3.2 times wider than head. Sclerotized buccal cavity oblong, comparatively narrow, 38 µm long and 17 µm broad. (Buccal cavity in L3: 32–35 × 13–15 µm; in L2: 26 × 10 µm.) Stomatal walls rather thin. No teeth or any denticle-like structures, only the so-called geusids (Siddiqi's term: minute foramina in the

basal sector of stoma) are present. Oesophagus 630 µm long. Base of oesophagus non-tuberculate. Posterior part of intestine with two (in L2–L3 larvae with two to four) distinct constrictions. Female genital primordium in 50 % of body length; so it may be supposed that the mature female is amphidelphic. Tail elongate-conoid, 325 µm long, 9 % of entire length of body, strongly bent ventrally with finely rounded tip. Caudal glands or terminal pore absent.

Due to the non-tuberculate cardial region and the slender buccal cavity this species belongs to the family Mononchidae. It can easily be distinguished from *Nullonchus* by having an atuberculate cardia of *Mononchus* type (*vs.* tuberculate, of *Anatonchus* type), a slender buccal cavity (*vs.* large and spacious), no caudal spinneret (*vs.* present), and a large body (3.5 mm *vs.* 1.0–1.9 mm). Besides, the present species is presumably didelphic (*Nullonchus* is mono-prodelphic).

From now on, a toothless genus is known in each family Mononchidae and Anatonchidae.

2. Presence of *organellum ovale* in *Prismatolaimus*

In a quite recent paper, I described a new *Oncholaimus* species from Ecuador, *O. dorsalis* Andrássy, 2001. Among others, it was characterised in having a peculiar small organ posterior to the cardia which I named *organellum ovale*. This organ of unknown function opens with an unusually large pore on the dorsal side of body.

Unfortunately, it escaped my attention that Coomans and Raski (1988) and Brzeski (1997) had observed a similar organelle close to the cardia in *Prismatolaimus novoporus* Coomans & Raski, 1988 on the one hand, and in *P. dolichurus* de Man, 1880 and *P. mulcoomus* Brzeski, 1997 on the other hand. What is remarkable, this *organellum ovale* is not to be found in every species of either *Onchulus* or *Prismatolaimus*. Is it present, it does occur in every specimen, both adult and juvenile.

In a recent soil sample originating from Chile, I also observed this *organellum ovale* with its large dorsal pore in a female specimen of *Prismatolaimus dolichurus*. Its short description is as follows.

Female: L = 1.03 mm; a = 43; b = 4.3; c = 2.7; V = 39 %; c' = 24.

A slender nematode with very long tail. Body 24 µm wide on the mid-region. Cuticle finely annulated and provided with thin scattered setae. Head at basis of cephalic setae 12 µm wide. Body at proximal end of oesophagus only 1.8 times wider than head. Cephalic setae 6 + 4, arranged in a one circle. Buccal cavity (from head end measured) 11 µm long. Its proximal end is armed with a fine dorsal toothlet and two minute subventral denticles. Amphid slit-like, 26 µm from anterior body end. Oesophagus 238 µm long,

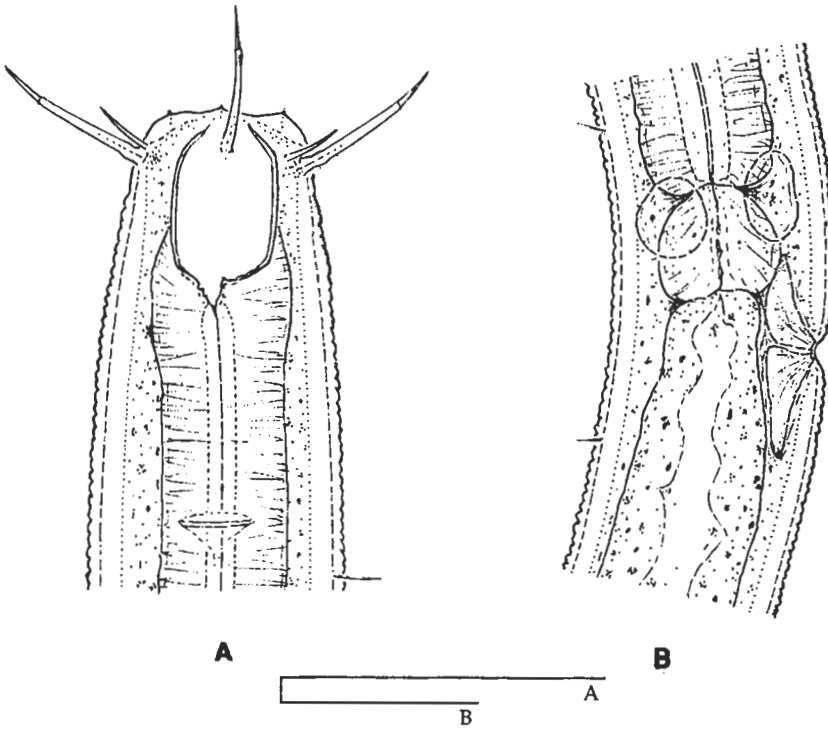


Fig. 2. *Prismatolaimus dolichurus* de Man, 1880, a female from Chile. A: anterior end; B: post-cardial region with *organellum ovale* and dorsal pore. (Scale bars 20 µm each)

cardia large, spheroid. *Organellum ovale* 18 µm long, apparently bilobed; dorsal pore conspicuous, located at 17 µm posterior to oesophagus. Amphidelphic, anterior gonad 2.6, posterior gonad 3 body diameters long. One egg: 62 × 18 µm. Distance vulva-anus 0.6 times as long as tail. Tail 380 µm, 37 % of total body length, 24 times as long as anal body width, with a minute claw-like appendage on tip.

In the course of my praxis, I several times expressed the opinion (*e.g.* in 1963 and 1976) that the genera *Prismatolaimus* de Man, 1880 and *Onchulus* Cobb, 1920 are closely relatives, and they belong to one and same family, Prismatolaimidae (syn. Onchulidae). Whereas, Coomans and Raski (1988) disagread this, in their opinion, the relation was less clear. Nevertheless, the presence of *organellum ovale* in both genera confirms now the supposed relationship between them.

1. ANDRÁSSY, I. (1964): Onchulidae n. fam., eine neue Familie der Ordnung Enoplida (Nematoda). – Opusc. Zool. Budapest, 5: 25–41.

2. ANDRÁSSY, I. (1976): Evolution as a basis for the systematization of nematodes. – London, pp. 288.

3. ANDRÁSSY, I. (2001): Some species of curious genera of the class Penetrantia (Nematoda). – Internat. Journ. Nematol., 11: 43–57.

4. BRZESKI, M. (1997): Studies on some species of the genus Prismatolaimus de Man, 1880 with description of P. mulcoomus sp. n. (Nematoda: Prismatolaimidae). – Ann. Zool., 46: 153–166.

5. COOMANS, A. & RASKI, D. J. (1988): Two new species of Prismatolaimus de Man, 1880 (Nemata: Prismatolaimidae) in Southern Chile. – Journ. Nematol., 20: 288–303.

6. SIDDIQI, M. R. (1984): Nullonchus, a new genus of toothless mononchs, with comments on the phylogenetic relationship of Nullonchinae n. subfam. (Nematoda: Mononchida). – Nematologica, 30: 11–21.

Communicatio Brevis

Dobatia goettingi Brandt, 1961 (Gastropoda: Clausiliidae) in Bulgaria

By

Z. P. ERÓSS* and Z. FEHÉR**

Abstract. Until now it was doubtful whether *Dobatia goettingi* Brandt occurs in Bulgaria. Although empty shells of this species had been collected in the Black Sea coastal region, but they were considered to be originated from Turkey. In the summer of 1997, the authors collected one live specimen in a mixed oak-beech forest in the Istranca Mountains (Strandža planina), near Malko Târnovo. This occurrence proves the presence of this species in Bulgaria.

Bulgaria is situated in the eastern part of the Balkan Peninsula, 25% of its mollusc species are Balkan endemisms, and Pontic elements have a great significance as well (14 %) (Damjanov & Likharev, 1975). Our knowledge about Bulgarian mollusc (and particularily Clausiliidae) fauna increased rapidly during the second half of this century (Urbanski, 1960b; Urbanski, 1978; Pintér, 1968; Pintér & Pintér, 1970; Sajó, 1968; Damjanov & Likharev, 1975).

Considering its distribution, *Dobatia goettingi* is a typical Pontic species, it lives in the northern and north-western part of Turkey (Németh & Szekeres, 1995; Schütt, 1996) in forests, mainly among the roots of dead and slightly decaying trees (Fig. 1). In Nordsieck's (1973) opinion it lives facultatively in caves as well. *Dobatia goettingi* does not occur in the European part of Turkey, and in Bulgaria only empty shells have been observed so far. An empty, bleached shell was collected from flotsam at the tide-flushed estuary of the Ropotamo River by L. Pintér (in the collection of the Natural History Museum, Budapest, NHMB 31230/1), three others were found at Kiten, at the foot of a cliff by Urbanski (1978) (Fig. 2).

It is well known that shells of the *Serrulina*-group can travel large distances over the Black Sea, e.g. Urbanski (1960a) reported to find *Filosa filosa* Mousson and *Euxina dipolauchen* O. Boettger near Burgas in flotsam,

* *Zoltán Péter Eröss*, 1154 Budapest, Bem u. 36, Hungary.

** *Dr. Zoltán Fehér*, Department of Zoology of the Hungarian Natural History Museum, 1088 Budapest, Baross u. 13, Hungary.

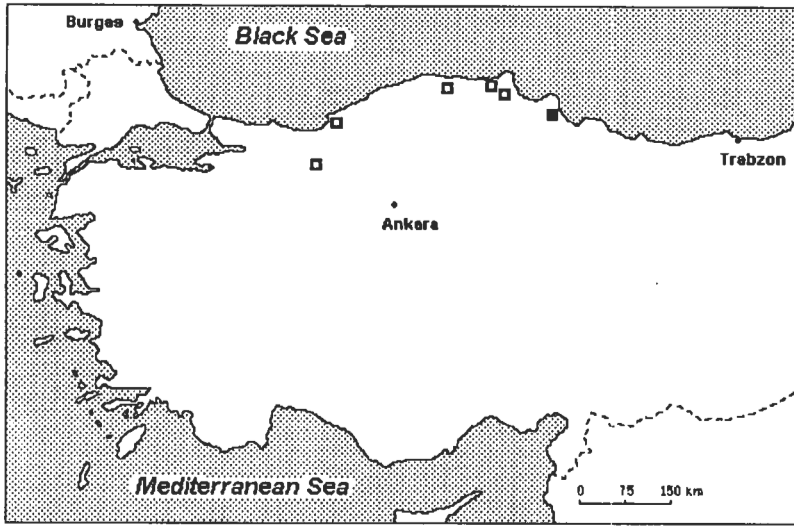


Fig. 1. Distribution of *Dobatia* in Turkey. Empty squares indicate *D. goettingi* Brandt, filled square indicates *D. mariae* Németh & Szekeres, which is considered a probable subspecies of the former one (M. Szekeres, personal communication)

in spite of they live east and southeast of the Black Sea. By the opinion of Németh & Szekeres (1995) *Dobatia* specimens, found in Bulgaria, could probably be originated from Turkey by drifting across the Black sea by east-west currents. Thus, until now the existence of *Dobatia goettingi* was rather doubtful in Bulgaria.

Materials and methods

Authors and Mr. Kornél Kovács took part in a field trip in the western region of the Balkan Peninsula between 24/07/1997 and 30/07/1997. Sampling was done by singling in 26 localities. Out of them 8 were in the area of the Southern Carpathians, 3 in the Balkan Mountains (Stara planina), 5 in the Rhodope Mountains, 6 in the Istranca Mountains (Strandža planina) and 4 in the coastal region of the Black Sea between Burgas and the Turkish border.

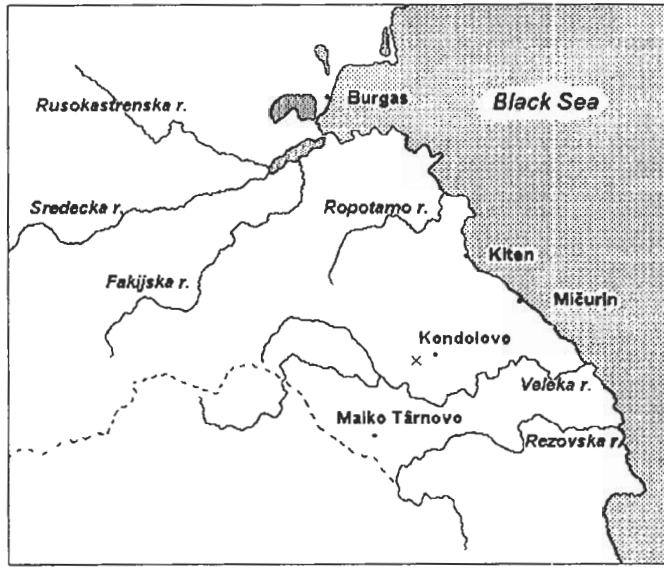


Fig. 2. Bulgarian occurrence of *Dobatia goettingi* Brandt (indicated by crosses)

Results

One live specimen of *Dobatia goettingi* was found in the locality: Istranca Mountains, on the road from Mičurin to Malko Târnovo, 3 km W of Kondolovo, 29/07/1997 in a mixed oak-beech forest, at a foot of a dead and fallen tree (NHMB 70855/1) (Figs. 2 and 3). This place is about 20 kilometres far from the sea. The following other species were found there: *Leiostyla (Euxinolauria) schweigeri* Götting, *Lauria cylindracea* Da Costa, *Euxina paulhessei* Lindholm, *Euxina circumdata* L. Pfeiffer, *Serrulina serrulata* L. Pfeiffer, *Laciniaria plicata* Draparnaud, *Lindholmiola girva* Frivaldszky and *Oxychilus deilus rumelicus* Hesse.

Conclusions

The fact, that only one specimen was found, does not contradict the former findings, i.e. in its Turkish area it is generally not abundant and due to

its subterranean life form, is difficult to find (M. Szekeres, personal communication). Considering the status of the specimen found, we can conclude that *Dobatia goettingi* does exist in Europe: inside the Istranca Mountains, Bulgaria.

The locality where the live specimen (NHMB 70855/1) was found belongs to the Veleka River's catchment area, but now our recent finding suggests, that the specimen found at the estuary of Ropotamo River (NHMB 31230/1) originates also from the Istranca Mountains. Thus, we can assume that *Dobatia goettingi* has a larger distribution area including the catchment areas of Veleka, Ropotamo and Rezovska rivers.

This data however do not answer the question: is this population a relict of a former large area, or the result of their present spreading?

Acknowledgements. Authors are grateful to Mr. László Pintér and Dr. Miklós Szekeres for revising the manuscript.

REFERENCES

1. DAMJANOV, S. G. & LIKHAREV, I. M. (1975): Fauna Bulgarica, 4. Gastropoda terrestria. - Acad. Sci. Bulgarica, Sofia, pp. 1-425.

2. NÉMETH, L. & SZEKERES, M. (1995): New and little known species of the Serrulina group from northern Turkey. - Arch. Molluskenkunde, 124: 93-96.

3. NORDSIECK, H. (1973): Zur Anatomie und Systematik der Clausilien, XII. Phaedusinae, I: Phaedusen aus Nepal und ihre systematische Stellung innerhalb der Unterfamilie. - Arch. Molluskenkunde, 103: 63-85.

4. PINTÉR, I. & PINTÉR, L. (1970): Mollusken aus Bulgarien. - Malakol. Abh. Mus. Tierk. Dresden, 3/8: 81-98.

5. PINTÉR, L. (1968): Über bulgarische Mollusken. - Malakol. Abh. Mus. Tierk. Dresden, 2/15: 210-230.

6. SAJÓ, I. (1968): Zur Clausiliidenfauna Bulgariens (Gastropoda). - Acta. Zool. Acad. Sci. Hung., 14: 447-454.

7. SCHÜTT, H. (1996): Landschnecken der Türkei. - Acta Biol. Benrodis, Suppl. 4: 1-497.

8. URBANSKI, J. (1960a): Neue Landschnecken aus Bulgarien (Orculidae und Pupillidae, Moll. Pulm.). Systematische, zoogeographische und ökologische Studien über die Molluskenfauna der Balkan-Halbinsel, IV. - Bull. Soc. Amis. Sci. Lettr. Poznan, Série D: 57-67.

9. URBANSKI, J. (1960b): Bemerkenswerte Clausiliiden (Moll. Pulm.) aus Bulgarien. Systematische, zoogeographische und ökologische Studien über die Molluskenfauna der Balkan-Halbinsel, VI. - Bull. Soc. Amis. Sci. Lettr. Poznan, Série D: 113-149.

10. URBANSKI, J. (1978): Bemerkenswerte Clausiliiden (Moll. Pulm.) der nördlichen Balkan-Halbinsel. Systematische, zoogeographische und ökologische Studien über die Molluskenfauna der Balkan-Halbinsel, XV. - Bull. Soc. Amis. Sci. Lettr. Poznań, Série D: 235-251.

INDEX